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**Computer-Mediated Training Tools to Enhance Joint
Task Force Cognitive Leadership Skills**

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COMPUTER-MEDIATED TRAINING TOOLS TO ENHANCE JOINT TASK FORCE COGNITIVE LEADERSHIP SKILLS

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COMPUTER-MEDIATED TRAINING TOOLS TO ENHANCE JOINT TASK FORCE COGNITIVE LEADERSHIP SKILLS

1. Introduction

A United States Joint Task Force (JTF) is comprised of organizational units from the US Army, Navy, Air Force, and Marines. JTF membership may also include organizations from the National Guard, reserve forces, the Coast Guard, and other governmental agencies. Notional JTF structure includes an air component, a ground component, a naval component, and other special component(s) as required. When forces are established on the ground for extended periods of time, the ground component often becomes the focal point of the JTF. Thus, **ground component forces current and future are likely to perform operations in which they must understand and be interdependent with the cultures of multiple services, governmental agencies, and countries in which operations are occurring.** Component forces of varied service origin in a Joint Task Force must bring to bear their optimal capability set to ensure mission success. For JTF staff members, having complete awareness and understanding of sister service capabilities and their respective service cultures is paramount to mission planning, and ultimately to mission success.

JTF staff member exposure to other services' capabilities, outside first assignment to a JTF, traditionally comes through service member professional and personal interaction at service formal military schools, colleges, and universities, including the US Army Command & Staff College, Marine Corps University, and US Naval War College. Additionally, some service members are extended the opportunity to participate in Joint Professional Military Education. However, not every JTF staff member has the opportunity to attend formal school, or necessarily gain the appreciation for other service competencies even while in formal school. **The objective of this effort is to develop a computer-mediated training environment that can rapidly enhance the cognitive leadership skills required for ground component officers and non-commissioned officers to be effective in a Joint Task Force.**

2. Background

2.1. Joint Operations

The US Army sees Joint Operations as a foundation for future warfighting (US Army, 2003a). The fundamental joint warfighting unit is a United States Joint Task Force (JTF), comprised of organizational units from the US Army, Navy, Air Force, and Marines. JTF membership may also include organizations from the National Guard, reserve forces, the Coast Guard, and other governmental agencies. JTFs include an air component, a ground component, a naval component, and other special component(s) as required. Component forces of varied Service origin in a Joint Task Force bring to bear their optimal capability set to ensure mission success; DOD (2003) emphasizes utilizing the strengths of all available Services, coalition nations, and resources in an integrated and networked joint force to achieve strategic objectives. The outlook of the Chairman of the joint Chiefs of Staff, as documented in Joint Vision 2020, is the achievement of a fully interoperable joint force that is capable of full spectrum dominance in the 21st century. The Office of Force Transformation (2003), Army (US Army, 2003b), and Navy (Landay, 2006) also see joint operations as a pillar of the transforming US military.

Under the purview of Joint Forces Command, the Combatant Commands have developed Joint Operating Concepts (JOCs) to provide the operational context for force transformation and establish the linkage between strategic guidance and the integrated application of joint force capabilities. These include the Major Combat Operations JOC (DOD, 2004b), Stability Operations JOC (DOD, 2004c), Homeland Security JOC (DOD, 2004a), and Strategic Deterrence JOC (DOD, 2004d). These Joint Operating Concepts outline key military capabilities as well as execution principles for carrying out actions. For example, the Major Combat Operations JOC seeks decisive conclusions to combat; it sets out desired capabilities for Command and Control, Battlespace Awareness, Force Application, Focused Logistics, and Protection; and it sets forth eleven principles for action, such as "Employ a joint, interagency and multinational force with collaborative processes" and "Generate relentless pressure by deciding and acting distributively" (DOD, 2004b). This level of coordination requires global situational awareness (DOD, 2004d), which, for JTF staff members, means that not only is having a complex understanding of the enemy essential, but also that having complete awareness and understanding of sister Service capabilities and their respective Service cultures is important both for mission planning and mission success.

Given that it relies on different Services working together effectively, jointness has a cognitive basis that is key to its success. This basis lies in a mutual understanding and shared sense of trust, identity, and commitment amongst personnel, leading to effective information exchange and a willingness to engage in cooperative behaviors. To date, however, little research has been directed toward this level of jointness, and further attention must be given to training and educating personnel into thinking and behaving jointly. As described above, not every JTF staff member has the opportunity to attend formal school, or to gain the appreciation for other Service competencies even while in formal school. As a result, current JTF staff members may not have a solid understanding of the capabilities that other Services contribute to the Joint Task Force.

To better serve the need for collaborative and shared situational awareness within Joint Task Forces, it is important to base training on a thorough understanding of human learning behavior and human interaction. Perla et al. (2000) used a game involving distributed team members to study how distributed teams build shared mental models. The results suggest that communication capability and shared visualization are important for effective teamwork. Ross-Witkowski (2004) summarized a workshop on operations analysis and network-centric operations. One of the recommendations with

respect to coalitions was that the military needs to study how trust is transmitted between coalition partners.

Coalition operations, as defined in JP 1-02, are an ad hoc arrangement between two or more nations for common action. They are similar to joint operations in that they bring together Services with different cultures, and they are therefore an important source for gleaning information about joint operations. Models have, for example, been produced of collegial decision making in an effects-based coalition operations context (McCrabb, 2002). Additionally, a recent working group on coalition operations determined that traditional coalition organization is ineffective in contemporary wars (CMO, 2000). Among other problems, the working group found too great an emphasis on interoperability of coalition technologies and too little emphasis on cooperation and other social and psychological issues. The group's recommendations included improving allied joint doctrine, the allied joint training system, and the allied joint professional military education system. More emphasis needs to be placed on the cognitive aspects of joint and coalition operations.

2.2. Culture

When forces are established on the ground for extended periods of time, the ground component often becomes the focal point of the JTF. Thus, ground component forces current and future are likely to perform operations in which they must understand and be interdependent with the cultures of multiple Services, governmental agencies, and countries in which operations are occurring. Military analysts are becoming increasingly aware of the important role which cognitive and social science factors play in military operations (Glasow and Ross-Witkowski, 2003).

To better understand cultural differences, Klein et al. (2000) describe factors used to model and describe cultures. These factors include power distance, dialectical reasoning, counterfactual thinking, risk assessment and uncertainty management, and activity orientation. Power distance, for example, measures the distribution of power in a culture; in cultures with high power distance, the power distribution is very unequal, whereas cultures with low power distance are more egalitarian. Handley and Levis (2001) examined differences in culture, military procedures, and command and control processes between the cooperating command centers in a multinational coalition. They developed a coalition model, using the cultural dimensions of power distance and uncertainty avoidance. In their simulations, virtual coalitions consisting of different combinations of nationalities were simulated and were measured on the timeliness and accuracy of their responses. Homogenous command centers scored highest on either one parameter or the other, while multi-national command centers scored highly in both parameters. This suggests that a combination of cultures, working together in concert, may provide better responses than a single-culture military.

However, McFate and Jackson (2005) note that the military does not have a centralized office for cultural knowledge. They suggest that creating one may help current programs avoid getting lost in bureaucracy. Such programs include the development of a human behavioral model that takes personality and cultural factors into account (Zachary et al., 2005), effects-based modeling which seeks to improve mental models of commanders and teams through computerized training exercises (Bakken et al., 2004), and also deals with distributed computing issues such as establishing a cultural framework for the interoperability of personnel along with their computational infrastructure (Slay, 2002).

2.3. Military Culture

Builder (1989) argues that each service's concepts of warfighting are based on how the services perceive their glory days of 1944-1945, the end of World War II. For example, he argues that the

Navy's finest moments came in the Pacific, where the US fleet overcame the Japanese fleet to win dominance in the Pacific. Consequently, according to Builder, fleet-vs.-fleet fighting became the dominant warfighting concept for the Navy, and the service spent the next several decades preparing to win a similar conflict against the Soviet Union, should it be necessary. In the Atlantic, the Navy spent World War II taking part in tasks such as escorting convoys and minesweeping, which, although necessary, were less glamorous than actions in the Pacific, and were therefore often overlooked in the services's subsequent perceptions of itself.

Similarly, Builder argues, the Air Force's finest moments came as it achieved air superiority over Europe, and the Army's finest moments came as it fought its way into Germany after the D-Day landings at Normandy. Consequently, in the decades following World War II, the Air Force's perception of warfighting involved heavy bombing and dog-fighting, but not necessarily close bombing runs in support of ground troops. The Army, meanwhile, prepared itself to fight a ground-based war in Central Europe. Even though engagements in Korea and Vietnam suggested that modern warfare was evolving, Builder argues that the Air Force and Army concepts of warfighting remained rooted in the successes of World War II rather than the more frustrating experiences later on.

2.4. Leadership

NATO (2004) notes that Soldiers are often involved in functions which involve much more interaction with civilians and foreign cultures than they may have been trained to handle. Interacting with foreign cultures often means handling different levels of power distance, tolerance of ambiguity, and individualism than a leader is used to dealing with. The cultural adaptability of teams, and especially their leaders, is therefore essential to mission success.

Requirements for leaders in today's military are becoming increasingly complex, and while some worry that current leaders are not up to the task (Ulmer, 1998), the Army has responded by making the improvement of leader and team performance one of its main research objectives (ARI, 2005). Improvement is often needed in areas which are not traditionally emphasized but have come to be key to contemporary leaders, such as functioning in joint operations and integrating coalition forces (Leonard et al., 2006). Cognitive factors such as information processing have become as important to leaders as observable behaviors (Brown, 2002); thus, in an effort to identify cognitive processes underlying military leaders' decisions, groups have even produced a computer model whose decisions in a tactical scenario were similar to those made by actual Joint Task Force commanders (Sokolowski, 2003).

Situational awareness (SA) for leaders has been the focus of a large amount of cognitive training efforts. Strater et al. (2004) developed computer-based training designed to increase SA in platoon leaders. The program consisted of two short modules, the first teaching time management and task prioritization skills, and the second focusing more generally on the information required for developing good SA. The program was tested using cadets in the Norwegian Army and Navy, who were instructed during a training exercise to attack a suspected enemy special forces camp. However, SA cues indicated that the camp in fact housed refugees, and squads were tested to see if their confidence in their SA would override orders to attack. Half of the cadets had received SA training, and although only two of eight squads recognized not to attack the camp, the two squads were both led by cadets who had received the SA training.

Similar work has focused on communication and situational awareness for military leaders. One of the findings of Strater et al. (2003) was that young leaders experience communication problems more often than they experience problems determining the combat readiness of their troops. Strater et al.

(2001) have also employed methods for measuring situational awareness. In training exercises, two different methods were used to measure platoon leader situational awareness. The first method, the Situation Awareness Global Assessment Technique (SAGAT), was computer-based; the second, the Situation Awareness Behaviorally Anchored Rating Scale (SABARS), was based on observation by human reviewers.

2.5. Current Training Methods

Currently, DOD is developing multiple computer-mediated software tools that challenge traditional training. For example, the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) developed *Think Like a Commander* (TLAC) training materials that deal with battlefield thinking habits that are characteristic of expert tactical thinkers (Shadrick and Luccier, 2004). In TLAC, a tactical scenario is presented using a slide presentation, and a tactical senior mentor leads a class of students through a structured analysis of the case. The Army Excellence in Leadership (AXL) project at the University of Southern California's Institute for Creative Technologies is advancing basic concepts developed in the TLAC environment using Hollywood storytelling techniques to create fictional filmed case studies which address specific leadership issues (Hill et al., 2004). In addition, the ARI ELECT project is developing training tools that will effectively train and sustain the Soldier-centered skills needed to function in current high stress environments. Several past SBIR projects developed individual leadership training modules (ARI, 2005), and five topics of the current SBIR solicitation will develop computer-mediated training environments tailored specifically to leadership skills development.

These programs form an important basis for understanding key capabilities required in a training tool for the military. These elements include:

- Existing electronically, allowing for easy distribution from a central location;
- Pretests or specific criteria to determine when a Soldier is properly prepared to participate in a particular exercise;
- Tools which allow rapid tailoring or modification of training materials;
- Semi-automated performance measurement and feedback; and
- Access to intelligent agents that, in collective training, can substitute for members of the training audience who are completing individual training or are not available for other reasons.

Other SBIR and research projects have been funded by ARI, TRADOC, and other DOD and non-DOD agencies as well. For example, the Virtual Soldier Skill Assessment project (Gately et al., 2005) developed a successful design and deployment of a prototype system to assess the cognitive decision-making skills of dismounted, small-unit (platoon, squad, or team) leaders in virtual urban environments. The question of what leaders of the future need to be prepared to do is an important one to address in developing training modules. Horey et al. (2004) reviewed and developed competency-based future leadership requirements and specifically highlight the importance of behavioral aspects of leadership, including comparison of Service framework constructs.

2.6. Mental Modeling

Mental modeling is a tool which may be used to map each Service's culture and then establish cross-Service communication. "Mental models" are an established concept in psychology. They have been the focus of extensive research (Morgan et al., 2002; Atman et al., 1994; Bostrom et al., 1992). Such research has shown that mental models are a complex web of deeply held beliefs that operate below the conscious level to affect how an individual defines a problem, reacts to issues, learns, and makes

decisions about messages and options concerning topics that come to their attention through communications. It is also well established that people's mental models vary in important but often unpredictable ways, strongly affecting their decision processes (Fischhoff and Downs, 1997). Research has demonstrated that the complexity of people's thinking makes it impossible to predict the effects of communication on people's mental models without empirical testing. However, testing methods must suit the research task. Polling and focus group methods lack sufficient depth to effectively identify and characterize mental models.

Mental models are usually used to conceptualize shared cognition, which has been shown to be an essential component of team effectiveness (Salas & Cannon-Bowers, 2001). Shared mental models are assumed to influence team performance through their impact on members' ability to engage in coordinated actions. Such shared mental models involve knowledge about the team's task, individual members' responsibilities, and potential situations the team may encounter.

Shared mental models can greatly facilitate communication and coordination in team settings (Graham and Matthews, 2000). Communication facilitates learning, helps build effective teams, and is an essential element of all collective human activity. In this way, it also is a foundation for successful leadership training. As mentioned above, the key to success in future operations lies in integrated contributions of all the partners in a Joint Task Force. It is thus important to develop cross-organizational links between different Services. However, meaningful dissemination of information depends on people's willingness to share and receive information, an area where communication and trust play vital roles.

Team members with similar knowledge bases and cognitive mechanisms are more likely to interpret information the same way and to make accurate projections about each other's decisions and actions. Without shared mental models, coordination and communication will likely take more time and effort, and more lapses will occur. Shared mental models can be enhanced by: (1) shared training, e.g., joint training or cross training on different job functions; (2) shared experiences, e.g., working together as a team or having similar experiences either together or individually; and (3) direct communications between team members to build up a shared mental model in advance of operations (Graham and Matthews, 2001).

2.7. Decision Analysis

Joint efforts are often hampered because those responsible for doing the planning are not familiar with or aware of the range of interests associated with an issue. From an "educating and informing" perspective, leadership training is fast evolving toward a process orientation, drawing upon state-of-the-art knowledge in communication sciences and decision analysis. Additionally, DOD leaders may benefit from using multi-criteria decision analysis (MCDA) to add formalism and structure to planning and communication challenges, including quantitative assessment of what must be modeled and how, who must be involved, and rules about what must be done given the mission goals.

MCDA refers to a group of methods used to impart structure to the decision-making process. Generally, these decision analysis methods consist of four steps: (1) creating a hierarchy of criteria relevant to the decision at hand, for use in evaluating the decision alternatives, (2) weighting the relative importance of the criteria, (3) scoring how well each alternative performs on each criteria, and (4) combining scores across criteria to produce an aggregate score for each alternative (Linkov et al., 2005). Most MCDA methodologies share similar steps 1 and 3, but diverge on their processes for steps 2 and 4 (Yoe, 2002). A detailed analysis of the theoretical foundations of different MCDA methods and their comparative strengths and weaknesses is presented in Belton and Stewart (2002).

Elementary MCDA methods can be used to reduce complex problems to a singular basis for selection of a preferred alternative. However, these methods do not necessarily weight the relative importance of criteria or combine the criteria to produce an aggregate score for each alternative. While elementary approaches are simple and can, in most cases, be executed without the help of a computer, these methods are best suited for single-decision maker problems with few alternatives and criteria.

More sophisticated MCDA methods are capable of handling problems with many decision makers, alternatives, and criteria. Multi-attribute utility theory (MAUT) and the analytical hierarchy process (AHP) are methods that use optimization algorithms, while outranking uses a dominance approach. The optimization approaches employ numerical scores to communicate the merit of each option on a single scale. Scores are developed from the performance of alternatives with respect to individual criteria and then aggregated into an overall score. Individual scores may be simply summed or averaged, or a weighting mechanism can be used to favor some criteria more heavily than others. The goal of MAUT is to find a simple expression for the net benefits of a decision. Through the use of utility or value functions, MAUT transforms diverse criteria into one common scale of utility or value. MAUT relies on the assumptions that the decision maker is rational (preferring more utility to less utility, for example), that the decision maker has perfect knowledge, and that the decision maker is consistent in his judgments. The goal of decision makers in this process is to maximize utility or value. Because poor scores on criteria can be compensated for by high scores on other criteria, MAUT is part of a group of MCDA techniques known as "compensatory" methods.

Similar to MAUT, AHP (Saaty, 1994) aggregates various facets of the decision problem using a single optimization function known as the objective function. AHP prioritizes the decision alternatives based on their objective function values, ranging from highest to lowest. Like MAUT, AHP is a compensatory optimization approach. However, AHP uses a quantitative comparison method that is based on pairwise comparisons of decision criteria, rather than utility and weighting functions. All individual criteria must be paired against all others and the results compiled in matrix form. For example, in examining the tasks associated with small arms, AHP would require the decision maker to answer questions such as, "With respect to small arms, which task capability is more important, neutralizing a target or avoiding detection?" A numerical scale is used to compare the choices, and AHP moves systematically through all pairwise comparisons of criteria and alternatives. AHP thus relies on the supposition that humans are more capable of making relative judgments than absolute judgments. Consequently, the rationality assumption in AHP is more relaxed than in MAUT.

Unlike MAUT and AHP, outranking is based on the principle that one alternative may have a degree of dominance over another (Kangas et al., 2001). Dominance occurs when one option performs better than another on at least one criterion and no worse than the other on all criteria (ODPM, 2001). However, outranking techniques do not presuppose that a single best alternative can be identified. Outranking models compare the performance of two (or more) alternatives at a time, initially in terms of each criterion, to identify the extent to which a preference for one over the other can be asserted. Outranking techniques then aggregate the preference information across all relevant criteria and seek to establish the strength of evidence favoring selection of one alternative over another. For example, an outranking technique may entail favoring the alternative that performs the best on the greatest number of criteria. Thus, outranking techniques allow inferior performance on some criteria to be compensated for by superior performance on others. They do not necessarily, however, take into account the magnitude of relative underperformance in a criterion versus the magnitude of overperformance in another criterion. Therefore, outranking models are known as "partially compensatory." Outranking techniques are most appropriate when criteria metrics are not easily aggregated, measurement scales vary over wide ranges, and units are incommensurate or incomparable (Seager, 2004).

3. Cognitive Leadership: Service Cultural Awareness Operational Capabilities and Environments

3.1. Front-End Analysis

Phase I consists of a front-end analysis to partially determine the awareness of Joint Task Force staff members of the cultural differences among the Services, the operational capabilities to which they are relevant, and the environments suitable to enhance awareness of cultural differences and associated capabilities.

The front-end analysis is a top-down examination that begins with the Joint Operating Concepts which serve as the guiding precepts for current and future war. The analysis sets forth a framework by which each Service's capabilities are presented *relevant* to each joint operational concept. Service Mission Essential Task Lists, albeit somewhat dated, describe *what* a Service warfighting command/unit is capable of doing. Within each Service, the major warfighting elements (Combat Arms, Combat Support, and Combat Service Support) serve as an additional level of granularity. Within the framework, the Service warfighting units are focused at the Brigade level and higher. When appropriate, examination of Service warfighter capability will be further described through the lens of DOTMLPF – Doctrine, Organization, Training, Materiel, Leadership & Education, Personnel, and Facilities. Finally, within the Doctrine element, a Service view of the battlefield (in terms of maneuver, fires, intelligence, logistics, force protection, information operations, and command & control) will also be presented.

The Service data captured for the front-end analysis must lend itself to inclusion in a computer-mediated training tool. As such, for Phase I, matrices will be used for information retention and presentation. The key components of the front-end analysis include:

- Joint Operating Concepts (JOC)
 - Major Combat Operations, *emphasized*
 - Stability Operations, *emphasized*
 - Homeland Security, *noted*
 - Strategic Deterrence, *not addressed*
- Service Mission Essential Task Lists (METL)
- Service Warfighting Unit, Brigade Level and Higher
- DOTMLPF elements as they pertain to the Warfighting Unit.
 - Doctrine: Maneuver, Fires, Intelligence, Logistics, etc.
 - Organization: Combat Arms, Combat Support, and Combat Service Support
 - Training: Live Fire / Force-on-Force / Simulation
 - Materiel: Unit Pacing Items
 - Leadership & Education: Rank & File
 - Personnel: Unit Strength
 - Facilities: Location / Deployment Means

Figure 1 and Figure 2 are pictorial representations of the construct for the front-end analysis.

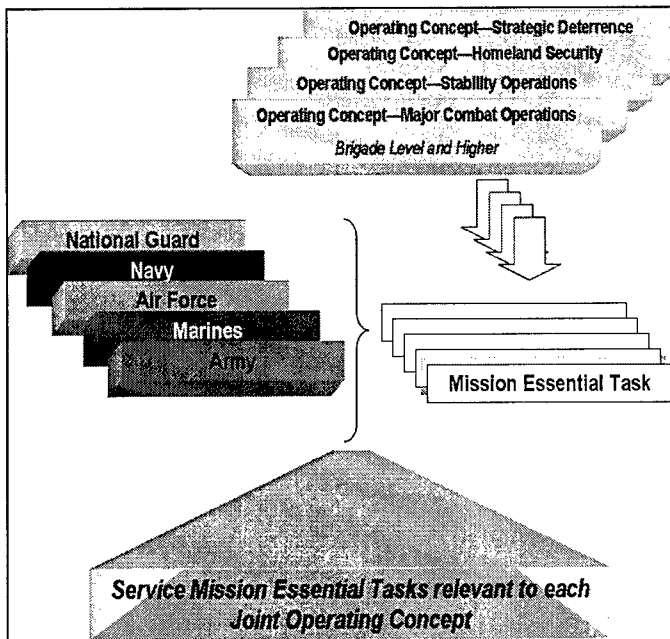


Figure 1: JOC-METL Relevance.

		Operating Concept—Strategic Deterrence						
		Operating Concept—Homeland Security						
		Operating Concept—Stability Operations						
		Operating Concept—Major Combat Operations						
		Brigade Level and Higher						
Services	Warfighting Unit	D	O	T	M	L	P	F
Army	Unit of Action							
Marines	MAGTF							
Air Force	Wing							
Navy	Battle Group							
National Guard	Unit of Action							

Figure 2: Service Warfighting Unit Construct.

The entire depth and breadth of information to be captured for each Service is beyond the scope of Phase I. Representative elements of Service information will be presented, understanding that if the tool is proven useful, further research will be necessary to complete the data capture. Although not fully verified, representative examples of the data capture are presented in Figure 3.

Service	Warfighting Unit	Doctrine	Organization	Training	Material	Leadership Personnel	Facilities
Army	Unit of Action	Maneuver Warfare	Corps-Division, BCT, ACR	Combined Arms-Force on Force	M1A2, M2A2 (BFV), Apache		Strategic Reserve Storage Activity Europe, Air, Land systems
Marines	MAGTF	Expeditionary Maneuver Warfare-Ship To Objective Maneuver	MAGTF-MEF, MEB, MEU	Combined Arms-Live Fire	Osprey, F-18, AAV, LAV, M1A1		Prepositioned, Amphibious, Land and Air systems
Air Force	Wing	Air Warfare	MAJCOM-Wing, Group	Air Combat-Close Air Support, Air Interdiction	F/A -18E, F/A-22A		Expeditionary Airfields
Navy	Battle Group	Naval Warfare: Sea Power 21-Sea Shield, Sea Strike, Sea Basing	Task Force		Surface Ships Aircraft Carriers Submarines		Air and Sea based platforms
National Guard	Unit of Action	Maneuver Warfare	Division, BCT	Combined Arms-Force on Force	M1A2, M2A2 (BFV), Apache		Strategic Reserve Storage Activity Europe, Air, Land systems

Figure 3: Major Combat Operations-Service DOTMLPF.

Information gleaned from research in Phase II will need to be verified with Service representatives. In examination of DOTMLPF, not all elements may necessarily prove instrumental for a Joint Staff Force planner to better appreciate the capabilities offered by a Service warfighting unit. In this example, data elements for Leadership and Personnel are omitted.

3.2. Joint Operating Concepts

As described above, the US Army sees Joint Operations as a foundation for future warfighting (US Army, 2003a). The Joint Operating Concepts (JOCs) are top-level DOD warfighting concepts (Major Combat Operations, Stability Operations, Homeland Security, and Strategic Deterrence) which provide the framework and guiding precepts relevant to Joint Operations, looking forward to the future over the next 15 years. Within the JOC framework, the services find a discussion of concepts and warfighting attributes intended to shape the forces of the future, influencing the relevance and design of both current and programmed capabilities. A JOC defines the operational-level descriptions of how a Joint Force Commander will accomplish a strategic mission through conduct of operational-level military operations within a campaign. Furthermore, the JOC identifies challenges, key ideas for solving those challenges, effects to be generated to achieve objectives, essential capabilities likely needed to achieve objectives, and the relevant conditions in which the capabilities must be applied. Top level guidance is further provided through examination of the Joint Functional Concepts (JFCs) – Force Application, Force Protection, Focused Logistics, Battlespace Awareness, Command & Control, Network Centric Operations, Force Management, and Training. A third complement to the conceptual framework is provided through the Joint Integrating Concepts (JICs). Together, JFCs and JICs examine the effects needing to be generated in JOCs to determine functional requirements and narrowly scoped capabilities needed to meet an operational objective. The Joint Staff Planner should have an understanding of the JOCs, the JFCs, and the JICS to better appreciate the aim to collectively synergize the full complement of capabilities within the Joint Task Force. Figure 4 provides a pictorial relationship among the Joint Operations Concepts Family of documents.

JOpsC Family

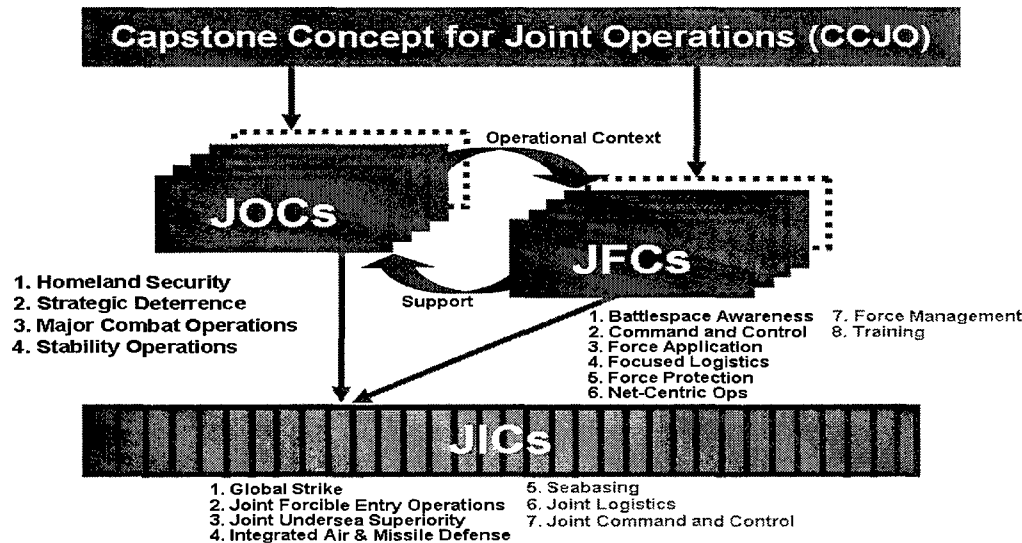


Figure 4: Family of Joint Operations Concepts Documents.

3.3. Universal Joint and Service Mission Essential Task Lists

The Chairman Joint Chiefs of Staff Manual (CJCSM) 3500.04D dated 1 August 2005 is entitled the Universal Joint Task List (UJTL). A document of nearly 900 pages, the UJTL serves as a menu of tasks, which serve as the foundation for capabilities-based planning across the range of military planning. When augmented with Service and applicable Defense agency task lists, the UJTL is a comprehensive, integrated description of functional tasks, conditions, measures, and criteria supporting all levels of DOD in executing the National Defense Strategy and Military Strategy (CJCSM 3500.04D, dated 1 August 2005, p. A-1).

Each Service describes its warfighting abilities utilizing another top-level document to list its service-specific tasks. In the broadest sense, the Service Task List lists mission tasks that each service's forces are capable to perform. In all, over 1100 service tasks are described among the services:

Service Tasks	
Service	Number
US Air Force Master Capabilities List (AFMCL)	194
US Army Universal Task List (AUTL)	433
Universal Naval Task List (UNTL)	315
US Marine Corps Task List (MCTL)	201
Total Service Tasks	1143

Table 1: Number of Service Tasks by Service.

Each Service has its own listing of tasks relevant to the tactical, operational, and strategic levels of war. While in some cases the lists pre-date the family of joint operational concepts, establishing relevance between the Service Task Lists and the JOpsC family of documents is germane to infusing service competencies in a *joint* context. For the purpose of Task II, representative Service tables (Army and Marine Corps) mapping JFCs to Service Tasks by JOC are found in tables below.

		Army			Marine Corps
BFA	Task Identifier		Task Identifier		
Maneuver	2.1	Perform Tactical Actions associated with Force Projection and Deployment	1.1	Conduct Expeditionary Operations	
	2.2	Conduct Tactical Maneuver	1.1.1	Conduct Ship-to-Objective Maneuver	
	2.3	Conduct Tactical Troop Movements	1.2	Offense	
	2.4	Conduct Direct Fires	1.2.0.18	Conduct Noncombatant Evacuation Operations	
	2.4.1	Conduct lethal Direct Fire against a Surface Target	1.2.1.16	Conduct Mobility Operations	
	2.4.2	Conduct Non-lethal Direct Fire against a Surface Target	1.2.1.16.1	Breach Obstacles	
	2.5	Occupy an Area	1.2.1.16.2	Conduct Gap Crossing Operations	
	2.5.4	Conduct Drop Zone Operations	1.3	Defense	
	2.5.5	Conduct Landing Zone Operations	1.3.3	Occupy and Control Battlespace	
			1.3.17	Conduct Counter-Mobility Operations	
Fires	3.1	Decide Surface Targets to Attack	3.1	Conduct Direct Fires	
	3.2	Detect and Locate Surface Targets	3.2	Conduct Indirect Fires	
	3.3	Employ Fires to Influence the Will, and Destroy, Neutralize, or Suppress Enemy Forces	3.3	Conduct Non-lethal Engagement	
	3.3.1	Conduct Lethal Fire Support	3.4.1.4	Coordinate NSFS	
	3.3.2	Conduct Nonlethal Fire Support—Offensive Information Operations	3.4.1.6	Coordinate Close Air Support	
	3.3.2.2	Conduct Electronic Attack			
Intel	1.1	Support to Situational Understanding	2.1	Plan Intel Support	
	1.1.1	Perform Intelligence Preparation of the Battlefield (IPB)	2.1.2	Prepare and refine Intel and Intel prep of the Battlefield	
	1.2	Support to Strategic Responsiveness	2.1.5	Plan and Coordinate Geodesy Imagery and Services (GI&S) Support	
	1.3	Conduct Intelligence, Surveillance, and Reconnaissance (ISR)	2.1.6	Plan and Coordinate Signals Intel	
	1.4	Provide Intelligence Support to Effects	2.1.8	Provide Tactical Counter-Intel/Human Intel Support	
			2.2	Collect	
			2.3	Produce	
			2.4	Disseminate	
			2.5	Utilize	

Table 2: Joint Operational Concept—Major Combat Operations: Joint Functional Concepts Relevant to Service Tasks.

		Army			Marine Corps
BFA	Task Identifier		Task Identifier		
Logistics	6.1	Provide Supplies	4.1	Supply	
	6.2	Provide Maintenance	4.1.1	Arm the Force	
	6.3	Provide Transportation Support	4.2	Transport	
	6.3.2.1	Conduct A/DACG Activities	4.2	Plan and Coordinate Transportation Services	
	6.4	Provide Sustainment Support	4.3	Maintain	
	6.5	Provide Force Health Protection in a Global Environment	4.3	Provide Maintenance	
			4.6.10	Provide Air Base Support Functions	
			4.6.11	Provide Airfield Support	
Command & Control	7.1	Establish Command Post Operations	5.1	Conduct Planning	
	7.2	Manage Tactical Information	5.1.1	Analyze Current Situation	
	7.3	Assess Tactical Situation and Operations	5.2	Communicate	
	7.4	Plan Tactical Operations Using the Military Decision Making Process/Troop Leading Procedures	5.2.2	Establish & Conduct Coordination/Liaison	
	7.4.1	Conduct the Military Decision Making Process	5.3	Direct Operations	
	7.5	Prepare for Tactical Operations	5.3.1	Establish a Force Headquarters	
	7.6	Execute Tactical Operations	5.4	Manage Resources	
	7.8	Conduct Continuous Operations	5.4.1	Man the MAGTF	
	7.10	Conduct Public Affairs Operations	5.4.3.6	Operate Arrival and Departure Airfield Control Group	
Force Protection	5.3	Conduct Survivability Operations	6.1	Local Security	
	5.3.1	Protect against Enemy Hazards within the AO	6.1.1	Conduct Counter-Reconnaissance	
	5.3.1.1	Protect Individuals and Systems	6.1.3	Conduct Local Security	
	5.3.1.2	Prepare Fighting Positions	6.1.4	Conduct Survivability Operations	
	5.3.1.3	Prepare Protective Positions	6.2	Protective Measures	
				Protect/Secure Operationally Critical Installations, Facilities and Systems	
	5.3.1.4	Employ Protective Equipment	6.2.1	Protect Systems and Capabilities	
			6.2.2	Protect Air Land Water LOCs	
			6.2.5	Conduct Electronic Warfare	
			6.2.6	NBC Measures	
			6.3	Employ Contamination Avoidance	
			6.3.1	Identify NBC Hazards	
			6.3.2		

Table 2 continued: Joint Operational Concept—Major Combat Operations: Joint Functional Concepts Relevant to Service Tasks.

Army			Marine Corps		
BFA	Task Identifier		Task Identifier		
Maneuver	2.2	Conduct Tactical Maneuver	1.1.2	Conduct a Demonstration	
	2.4	Conduct Direct Fires	1.2.04	Navigate	
	2.4.1	Conduct Lethal Direct Fire Against a Surface Target	1.2.0.14	Conduct a Show of Force	
	2.4.2	Conduct Nonlethal Direct Fire Against a Surface Target	1.2.0.15	Conduct an Exploitation	
	2.5	Occupy an Area	1.2.0.18	Conduct Noncombatant Evacuation Operations (NEO)	
			1.2.1.31	Seize/Secure a Facility/Location	
			1.3.7	Provide Convoy Security	
Fires	3.1	Decide Surface Targets to Attack	3.1	Conduct Direct Fires	
	3.2	Detect and Locate Surface Targets	3.2	Conduct Indirect Fires	
	3.3	Employ Fires to Influence the Will, and Destroy, Neutralize, or Suppress Enemy Forces	3.3	Conduct Non-lethal Engagement	
	3.3.1	Conduct lethal Fire Support	3.4.1.4	Coordinate NSFS	
	3.3.2	Conduct Non-lethal Fire Support-Offensive Information Operations	3.4.1.6	Coordinate Close Air Support	
	3.3.2.2	Conduct Electronic Attack			
Intel	1.1.4	Conduct Police Intelligence Operations	2.1	Plan Intel Support	
	1.1.4.1	Collect Police Information	2.2.1	Collect Combat and Intel data	
	1.1.4.2	Conduct Police Information Assessment Process	2.3.2	Production of Intel Products	
	1.1.4.3	Develop Police Intelligence Products	2.4.4	Disseminate and Integrate Intelligence	
	1.4	Provide Intelligence Support to Effects	2.5	Utilize	
	1.4.2	Provide Intelligence Support to Information Operations	2.5.2	Perform Threat Evaluation	
	1.4.2.1.1	Provide Intel Support to PSYOPS			
	1.4.2.3.1	Provide Intel Support to Civil-Military Opns			
	1.4.2.3.2	Provide Intel Support to Public Affairs			
Logistics	6.1	Provide Supplies	4.1	Supply	
	6.2	Provide Maintenance	4.1.1	Arm the Force	
	6.3	Provide Transportation Support	4.2	Transport	
	6.4	Provide Sustainment Support	4.2	Plan and Coordinate Transportation Services	
	6.5	Provide Force Health Protection in a Global Environment	4.3	Maintain	
			4.3	Provide Maintenance	
			4.6	Services	
			4.6.1	Assist Host nation in populace and resource Control	
			4.6.4	Plan, Coordinate and Manage Refugee Operations	

Table 3: Joint Operational Concept—Stability Operations: Joint Functional Concepts Relevant to Service Tasks.

		Army			Marine Corps
BFA	Task Identifier			Task Identifier	
Command & Control	7.1	Establish Command Post Operations		5.1	Conduct Planning
	7.2	Manage Tactical Information		5.1.1	Analyze Current Situation
	7.3	Assess Tactical Situation and Operations		5.2	Communicate
	7.4	Plan Tactical Operations Using the Military Decision Making Process/Troop Leading Procedures		5.2.2	Establish & Conduct Coordination/Liaison
	7.5	Prepare for Tactical Operations		5.3	Direct Operations
	7.6	Execute Tactical Operations		5.3.1	Establish a Force Headquarters
	7.8	Conduct Continuous Operations		5.4	Manage Resources
	7.10	Conduct Public Affairs Operations		5.4.2.3	Insert Follow-On Forces
				5.4.3.5	Operate a Port Operations Control Group
				5.4.3.6	Operate Arrival and Departure Airfield Control Group
Force Protection	5.3	Conduct Survivability Operations		6.1	Local Security
	5.3.1.1	Protect Individuals and Systems		6.1.1	Conduct Counter-Reconnaissance
	5.3.1.4	Employ Protective Equipment		6.1.2	Establish Perimeter Security
	5.3.1.9	Conduct SEAD		6.1.3	Conduct Local Security
	5.3.5	Conduct Security Operations		6.2	Protective Measures
	5.3.5.4	Conduct Area Security Operations		6.2.1	Protect/Secure Operationally Critical Installations, Facilities and Systems
	5.3.5.4.2	Conduct Convoy Security Operations		6.3	NBC Measures
	5.3.5.4.3	Conduct Route Security Operations		6.4.1	Coordinate Management of Refugees
	5.3.5.5	Conduct Local Security Operations			
	5.3.5.6	Employ Operations Security			
	5.3.8	Conduct Tactical Counter-intel in the Area of Operations			
	5.3.8.2	Perform Counterintelligence			
	5.3.8.3	Perform Counter HUMINT (Human Intel)			
	5.3.8.4	Perform Counter IMINT (Imagery Intel)			
	5.3.8.5	Perform Counter SIGINT (Signal Intel)			
	5.3.8.6	Perform Counter MASINT (Measure and Signal intel)			
Conduct Tactical Mission Tasks and Operations	8.3	Conduct Stability Operations		This BFA is not recognized as a separate and distinct entity in the USMC	
	8.3.1	Conduct Peace Operations			
	8.3.1.1	Conduct Peacekeeping Operations			
	8.3.1.2	Conduct Peace Enforcement Operations			
	8.3.1.3	Conduct Operations in Support of Diplomatic Efforts			
	8.3.2	Conduct Foreign Internal Defense Operations			
	8.3.2.1	Provide Indirect Support to Foreign Internal Defense			
	8.3.2.2	Provide Direct Support to Foreign Internal Defense (not involving Combat Operations)			
	8.3.3	Conduct Security Assistance			
	8.3.4	Conduct Humanitarian and Civic Assistance			
	8.3.8	Perform Noncombatant Evacuation Operations			
	8.3.10	Conduct a Show of Force			
	8.4	Conduct Support Operations			
	8.4.2	Conduct Foreign Humanitarian Assistance			
	8.4.3.1.2	Provide Humanitarian Relief			

Table 3 continued: Joint Operational Concept—Stability Operations: Joint Functional Concepts Relevant to Service Tasks.

		Army			Marine Corps
BFA	Task Identifier		Task Identifier		
Maneuver	2.1	Perform Tactical Actions Associated with Force Projection and Deployment	1.1	Conduct Expeditionary Operations	
	2.2	Conduct Tactical Maneuver	1.3.8	Neutralize an Enemy Force	
	2.4	Conduct Direct Fires	1.4.1	Forward Deploy Units	
	2.4.1	Conduct Lethal Direct Fire Against a Surface Target	1.4.4	Deploy Tactical Forces and Conduct Reception Staging, Onward Movement, and Integration	
	2.4.2	Conduct Non-Lethal Direct Fire Against a Surface Target			
	2.5	Occupy an Area			
Fires	3.2	Detect and Locate Surface Targets to Attack	3.1	Conduct Direct Fires	
	3.3	Employ Fires to Influence the Will, and Destroy, Neutralize, or Suppress Enemy Forces	3.2	Conduct indirect Fires	
	3.3.1	Conduct Lethal Fire Support	3.3	Conduct Non-Lethal Engagement	
	3.3.2	Conduct Non-Lethal Fire Support- Offensive Information Operations	3.4	Conduct Targeting	
Intel	1.1.1	Perform Intelligence Preparation of the Battlefield (IPB)	2.1.1	Prepare and Refine IPB	
	1.3	Conduct Intelligence, Surveillance and Reconnaissance	2.1.7	Plan and Coordinate Counter-reconnaissance	
	1.4	Provide Intelligence Support to Effects	2.2.2	Conduct Reconnaissance and Surveillance	
Logistics	6.1	Provide Supplies	4.1	Arm the Force	
	6.2	Conduct Maneuver and Mobility Support Operations	4.2	Transport	
	6.3	Provide Transportation Support	4.3	Provide Maintenance	
	6.4	Provide Sustainment Support			
Command & Control	7.2.3	Display a Common Operational Picture Tailored to User Needs	5.1	Conduct Planning	
	7.4	Plan Tactical Operations Using the Military Decision Making Process	5.1.7	Conduct Rapid Response Planning	
	7.5	Prepare for Tactical Operations	5.4.2	Conduct Continuous Operations	
	7.6	Execute tactical Operations	5.4.3	Coordinate and Integrate Joint, Multi-National, and Interagency Support	
	7.8	Conduct Continuous Operations			
Force Protection	5.3.4.4	Provide Support to the U.S. Secret Service	6.1.1	Conduct Counter-Reconnaissance	
	5.3.5.4	Conduct Area Security Operations	6.1.3	Conduct Local Security	
	5.3.5.5	Conduct Local Security Operations	6.2.1	Protect/Secure Operationally Critical Installations, Facilities, and Systems	
	5.3.5.5.5	Conduct Critical Installations and Facilities Security	6.4.2	Conduct Military Law Enforcement	
	5.3.6	Combat Terrorism in Area of Operations	6.5.2	Conduct Tactical Counter-Intelligence	
	5.3.7.7	Perform Computer Network Defense	6.5.3	Combating Terrorism	
	5.3.8	Perform Tactical Counterintelligence in the Area of Operations (AO)			

Table 4: Joint Operational Concept--Homeland Security: Joint Functional Concepts Relevant to Service Tasks.

As a complement to these record tables, note pages providing clarification and detail are offered as additional information. For example:

3.4. Major Combat Operations: U.S. Army and USMC Battlefield Perspectives

Maneuver

The primary difference in this Battlefield Functional Area (BFA) is that the Army primarily conducts ground tactical maneuver, while the USMC conducts expeditionary operations, in particular ship to objective maneuver (STOM), although both Services fight as a part of a Land Component element.

The Army conducts airborne operations (drop zone and landing zone operations in the matrix respectively) as a part of maneuver to seize terrain, whereas the USMC conducts STOM to secure, reinforce and expand lodgment areas.

The USMC includes mobility tasks such as obstacle breaching, gap crossing, and river crossing operations as a part of the maneuver BFA, whereas the Army delineates such mobility tasks as a part of a separate BFA entitled Mobility/counter-Mobility/Survivability.

Both Services include force projection and deployment actions as related to the maneuver BFA such as conduction reception, staging, onward movement, and integration (RSOI) operations.

The USMC includes Noncombatant Evacuation Operations (NEO) as a subtask of offense under the maneuver BFA.

The Army incorporates the conduct of lethal and non-lethal direct fire against a surface target as a subtask under the maneuver BFA.

Fires

As previously noted above, IO is not a BFA within either Service; however, it's imperative to note that the Army conducts Non-Lethal Fire Support as a part of offensive IO within the fires BFA.

The Army includes electronic attack (electronic warfare) as a part of fires, whereas the USMC integrates EW under fires as well as force protection.

The USMC conducts Naval Surface Fire Support (NSFS) and employs Air Naval Gun Liaison Companies (ANGLICO) to "call in" NSFS.

The USMC includes the coordination of Close Air Support (CAS) as a task under fires.

The USMC includes the suppression of enemy air defenses (SEAD) as a fires task.

Intelligence

The most significant difference between the Army and USMC with regards to the intelligence BFA is the fact that the Army provides intelligence support to force protection and conducts police intelligence operations as a part of the intelligence BFA. Both of these Army intelligence subtasks are under the purview of the overarching task of support to situational understanding.

The USMC subdivides the intelligence BFA into the categories of plan, collect, produce, disseminate, and utilize, respectively.

Logistics

The primary difference between the two services within the logistics BFA is that the Army includes Arrival and Departure Airfield Control Group (A/DACG) operations in support of troop movement by air, whereas the USMC incorporates this task as a part of the Command and Control (C2) BFA.

Both Services are identical with regards to how they fix, arm, and refuel their respective forces as indicated in the matrix.

Command and Control

Although not depicted as a task by either Service, the Army primarily uses the Maneuver Control System (MCS) at brigade level to C2 forces, whereas the USMC uses Command and Control Personal Computer (C2PC) system.

The Army conducts the Military Decision Making Process (MDMP), whereas the USMC conducts a Rapid Planning Process.

The USMC explicitly enumerates the MAGTF as a task under resource management based on the fact that it doctrinally deploys as such.

The USMC includes A/DACG operations as apart of its C2 BFA.

The Army conducts public affairs operations as a supporting task in the C2 BFA. Inclusive in Army public affairs operations are the execution of information strategies, media operations, and maintenance of community relations which have both operational and strategic impact for a JTF.

Force Protection

The major difference to note is that the Army does not specify force protection as a BFA, whereas the USMC explicitly states it as such in its universal service task list. The Army's force protection tasks are implicitly stated as a part of a separate BFA entitled Mobility/Counter-Mobility/Survivability.

The USMC explicitly states survivability operations as a force protection task, whereas the army views these functions as separate and distinct and lists them under the Survivability BFA.

The USMC explicitly calls out the protection of air, land, and water lines of communication (LOCs) and conduct of electronic warfare (EW) as force protection tasks. The Army integrates EW under the fires BFA.

3.5. Stability and Support Operations: U.S. Army and USMC Battlefield Perspectives

Stability Operations are defined by the Stability and Support Operations (SASO) Joint Operating Concept (JOC) as "imposing *the security required to facilitate the transition to and reconstruction of a "new" normal once major conventional combat operations cease.*" The JTF conducts SASO in conjunction with all phases of major combat operations: pre-crisis, during major conventional combat operations and post crisis or post war. Accordingly, the Army and USMC Service tasks that depict how the Army and USMC view the battlefield in relation to the SASO JOC are outlined below.

The most noteworthy difference between Army and USMC BFA perspectives with regard to the SASO JOC is that the Army has a BFA entitled "Conduct Tactical Mission Tasks and Operations" that contains the preponderance of its SASO related tasks as depicted in the table above.

Maneuver

The most significant difference between the two Services in this BFA is that the USMC integrates noncombatant evacuation operations (NEO), conduct a demonstration, conduct a show of force, conduct a feint, and conduct a pursuit as a part of the maneuver BFA.

The USMC includes convoy security – which is conducted during all phases of SASO – as a maneuver task, whereas the Army integrates this task as a subtask of its Survivability BFA – Conduct convoy security operations.

Fires

As previously noted for this BFA, for the MCO JOC, the primary difference between the two Services is the fact that the Army integrates electronic warfare as a part of fires to shape the security environment, while the USMC integrates NSFS, ANGLICO, and coordinates CAS as a part of the fires BFA to influence the security environment.

Intelligence

The Army focuses intelligence efforts in this BFA on supporting police intelligence gathering operations and developing police intelligence products.

The Army provides intelligence support to information operations, civil-military operations, and public affairs operations as a part of its overarching strategy to accomplish the task of providing intelligence support to effects.

Logistics

There were not any significant differences or similarities to note between the two Services with regard to how they replenish, refuel, or re-arm their forces.

The USMC implements host nation resource management support operations and refugee operations as a logistics function.

Command and Control

The USMC integrates Arrival and Departure Airfield control Group (A/DACG) operations and Port Operations Control Group operations as subtasks of C2.

The Army perspective of C2 as it relates to SASO focuses on the planning preparation for and execution of tactical operations, whereas the USMC expands this BFA by including communications, i.e. establishing and conducting coordination and resource management as subtasks under the C2 BFA.

Force Protection

The Army integrates suppression of enemy air defense assets (SEAD) as a force protection measure.

The Army employs additional force protection measures in relation to performing counter intelligence tasks: counter human intelligence, counter imagery intelligence, counter signal intelligence, and counter measure and signal intelligence, which is inclusive of radar and acoustic intelligence.

The USMC integrates the coordination of refugee management operations as a task in the force protection BFA.

Conduct Tactical Mission Tasks and Operations

This Army exclusive BFA constitutes the primary difference between the two services regarding force protection as it relates to SASO. The army explicitly states that conduct stability operations and conduct peace operations are separate and distinct tasks.

The Army integrates operations in support of diplomatic efforts, indirect and direct support to foreign internal defense operations, humanitarian and civic assistance operations (as a part of the overarching task of support operations), and NEO into this BFA with respect to SASO.

3.6. Service Warfighting Unit – Brigade and Higher

For the Joint Force Staff planner, the three DOTMLPF elements **Doctrine**, **Organization**, and **Material** serve as the key attributes to articulate the capabilities of a Service Warfighting Unit. Notionally, the Joint Operating Concepts (further mapped to Service Mission Task Lists) are made relevant in terms of the Service's Doctrine, Organization, and Materiel. See Figure 5.

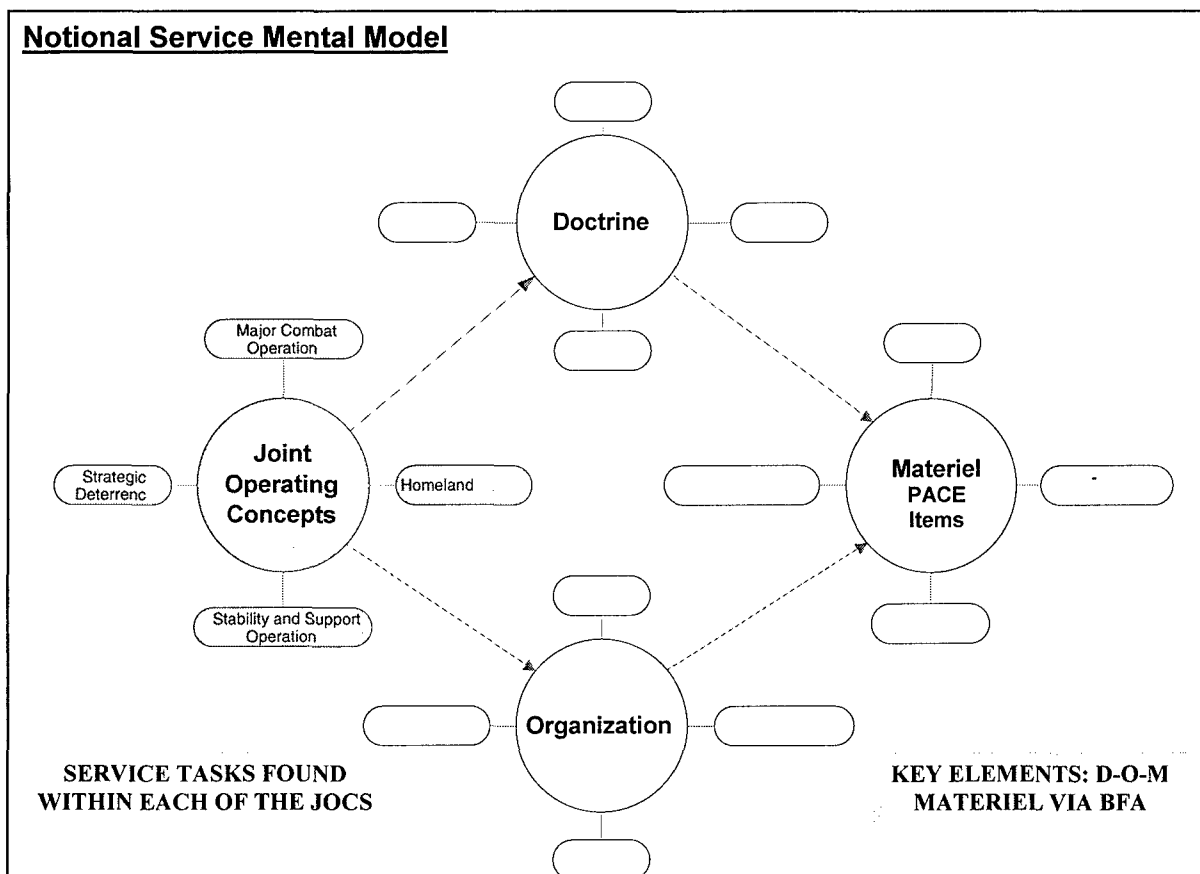


Figure 5: Joint Operating Concepts Relevant To Key DOTMLPF Elements

Using the Marine Corps to demonstrate, the following is described: Marine Corps doctrine demands expeditionary, maneuver warfare with units organized via Marine Air-Ground Task Forces (MAGTF). The MAGTF is comprised of 4 elements: Command Element, Air Combat Element, Ground Combat Element, and a Combat Service Support Element. MAGTFs analogous to brigade level and higher are the Marine Expeditionary Force (approximately 45,000 personnel), the Marine Expeditionary Brigade (approximately 15,000 personnel), and the Marine Expeditionary Unit (approximately 2200 personnel). Overwhelming force is achieved through the use of combined arms

delivered simultaneously. Simplistically stated, Force Application, a Joint Functional Concept for the Joint Operating Concept Major Combat Operations, is achieved by the Marine Organization applying their Doctrine through the use of their Materiel warfighting capabilities. Figure 6 is an extension of Figure 5 relevant to the US Marine Corps; Figure 7 is relevant to the US Army.

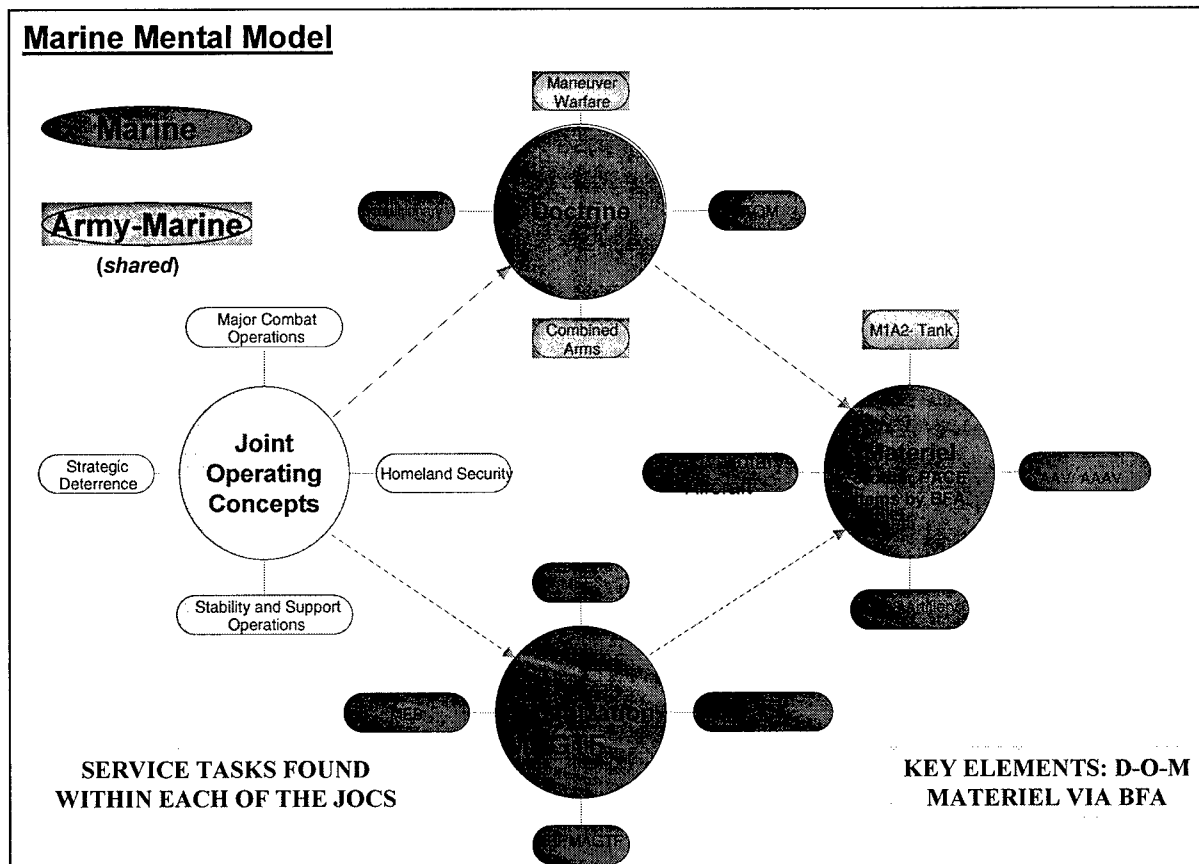


Figure 6: Joint Operating Concepts Relevant To Key Marine Corps DOTMLPF Elements.

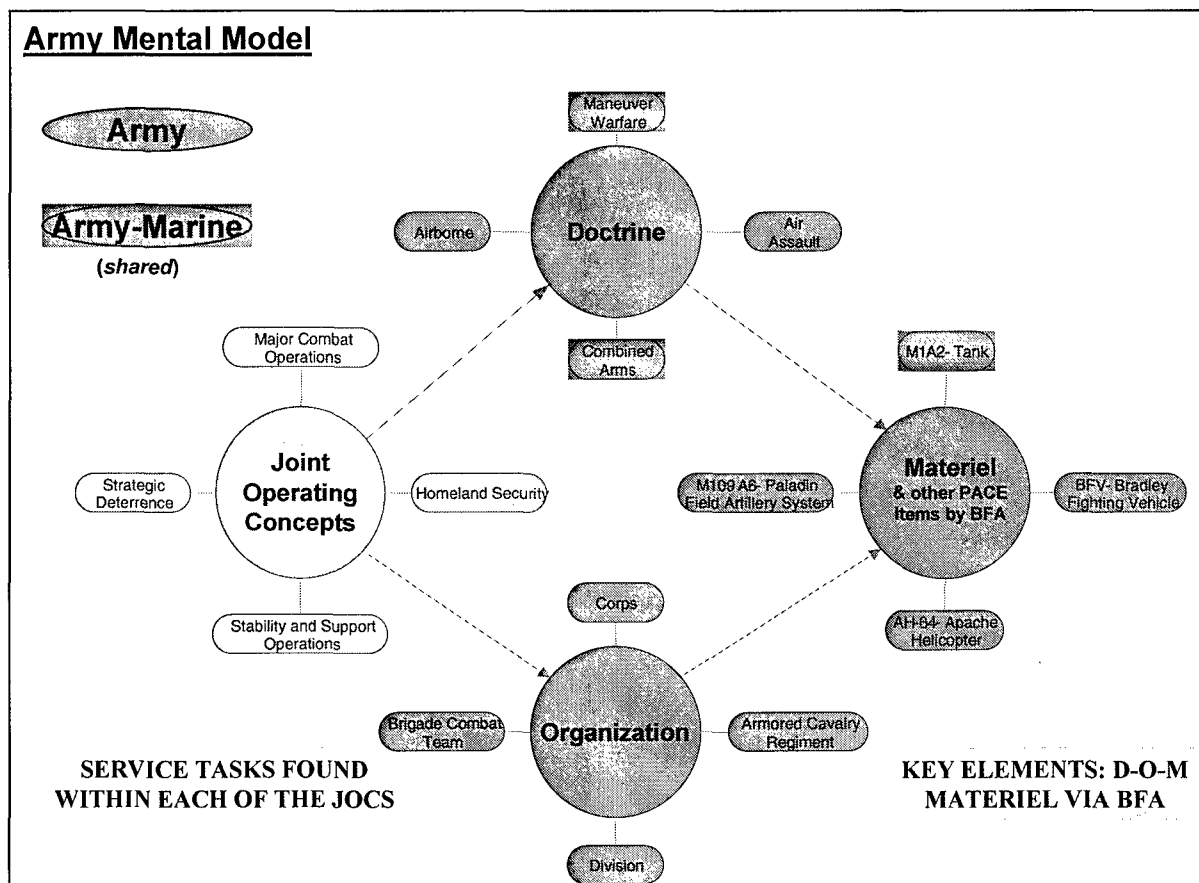


Figure 7: Joint Operating Concepts Relevant To Key Army DOTMLPF Elements.

Note the shared selected Doctrinal and Materiel elements between the Marine Corps and the Army. For joint mission planning, the Joint Task Force planner will need to be aware of complementary and redundant warfighting capabilities amongst the service warfighting units. While Figure 6 and Figure 7 are macro-level depictions of the mental model, complete database records will be created in Phase II to capture key elements of information. In a broader context reflective of the four major services, a representative example is provided in Table 5. Note pages, similar to those described above, offer clarification and additional detail. Service pacing items – items deemed critical to the successful conduct of combat missions – best describe warfighting ability. Key pacing items are described in terms of Battlefield Functional Areas. In the following example for the Battlefield Functional Area Maneuver, the following note pages are offered:

Maneuver

Army: Primary ground maneuver systems are the M1A2 Tank and M2A2 BFV for brigade level commands. The Comanche is primarily designed for reconnaissance but can fulfill an *attack role* and was slated to replace the OH-58D (Recon helicopter) in 2006.

Marines: The suite of Marine Corps maneuver vehicles is comprised of the AAV, AAV, LAV, M1A1 Tank, and V-22 Osprey.

Air Force: The primary fighter jets used for aerial combat are the F/A-18E and F/A- 22A.

Navy: Modern US Navy **Guided Missile Cruisers** perform primarily in a Battle Force role. Due to their extensive combat capability, these ships have been designated as Battle Force Capable (BFC) units. These multi-mission ships are capable of sustained combat operations in any combination of Anti-Air, Anti-Submarine, Anti- Surface, and Strike warfare environments. They are built to be employed in support of Carrier Battle Groups, Amphibious Assault Groups, as well as interdiction and escort missions. Thirty-one SPRUANCE-class **Destroyers** were developed for the primary mission of anti-submarine warfare, including operations as an integral part of attack carrier forces. Utilizing highly developed weapons systems, SPRUANCE is designed to hunt down and destroy high speed submarines in all weather, but can also engage ships, aircraft, and shore targets. These multi-purpose combatants are also capable of providing naval gunfire support in conjunction with Marine amphibious operations worldwide. The **Wolverine** will be used for brown water operations and is the primary boat that outfits squadrons responsible for brown water operations that are assigned to the newly formed Navy Expeditionary Combat Command.

**"M" for Materiel (DOTMLPF)
Selected Pacing Items by Service
Relevant to Battlefield Functional Areas**

Service	Maneuver	Fires	Intel	Logistics	C2	Force Protection
Army	M1A2, M2A2 (BFV), AH-64 Apache, OH-58D Kiowa Warrior, Comanche	M109A6 Paladin 155mm Self Propelled Howitzer (SPH), M198 Medium Towed Howitzer	LRAS3, Ground surveillance radar systems	M978 (Fuel Tanker), M985 (Ammo/Cargo Truck and Wrecker), CH-47 Chinook	M1A2, M2A2 (BFV)	M1A2, M2A2 (BFV), AH-64 Apache, Q36 and Q37 radars
Marines	AAV, AAV, LAV, M1A1 V-22 Osprey	M198 Medium Towed Howitzer F/A -18, Cobra Gunship	Ground surveillance radar systems	Fuel Tankers, Ammo Trucks, V-22 Osprey	M1A1, F-18	M1A1, LAV Cobra Gunship
Air Force	F/A-18E, F/A-22A, F117A Nighthawk Stealth Fighter	B1 AND B2 Bombers, A10 Warthog	Reconnaissance and surveillance aircraft	KC-135 Stratotanker	F/A-18E, F/A-22A	F/A-18E, F/A-22A, AN FPS 115 radar
Navy	Aircraft Carriers, Guided Missile Cruisers, Destroyers, Wolverines	Guided Missile Cruisers, Destroyers	Reconnaissance and surveillance aircraft ANSPQ-11, SURTASS	Military Sealift Command (MSC) ships	Command ships (AGF-3, AGF-11) Amphibious Command ships (LCC-19, LCC-20)	Frigates
National Guard	M1A1, M2A2 (BFV), AH-64 Apache, OH-58D Kiowa Warrior	M109A4 SPH, M198 Medium Towed Howitzer	Ground surveillance radar systems	Ditto Army	Ditto Army	M1A1, M2A2 (BFV), AH-64 Apache

Table 5: Service Pacing Items Relevant to Combat Capability.

3.7. Task II Summary

The key components of the front-end analysis facilitate a database structure of information relevant to Service warfighting units at the brigade level and higher. Figure 8 shows the components of the construct for the Front End Analysis. The construct allows for the mapping of top-down joint warfighting concepts to service tasks, and then further describes capabilities via select elements of DOTMLPF with particular focus on Doctrine, Organization, and Materiel. Finally, the DOM is further described in terms of Battlefield Functional Areas. The data-mining, while rather extensive and potentially exhausting, will need to be verified by Service representatives.

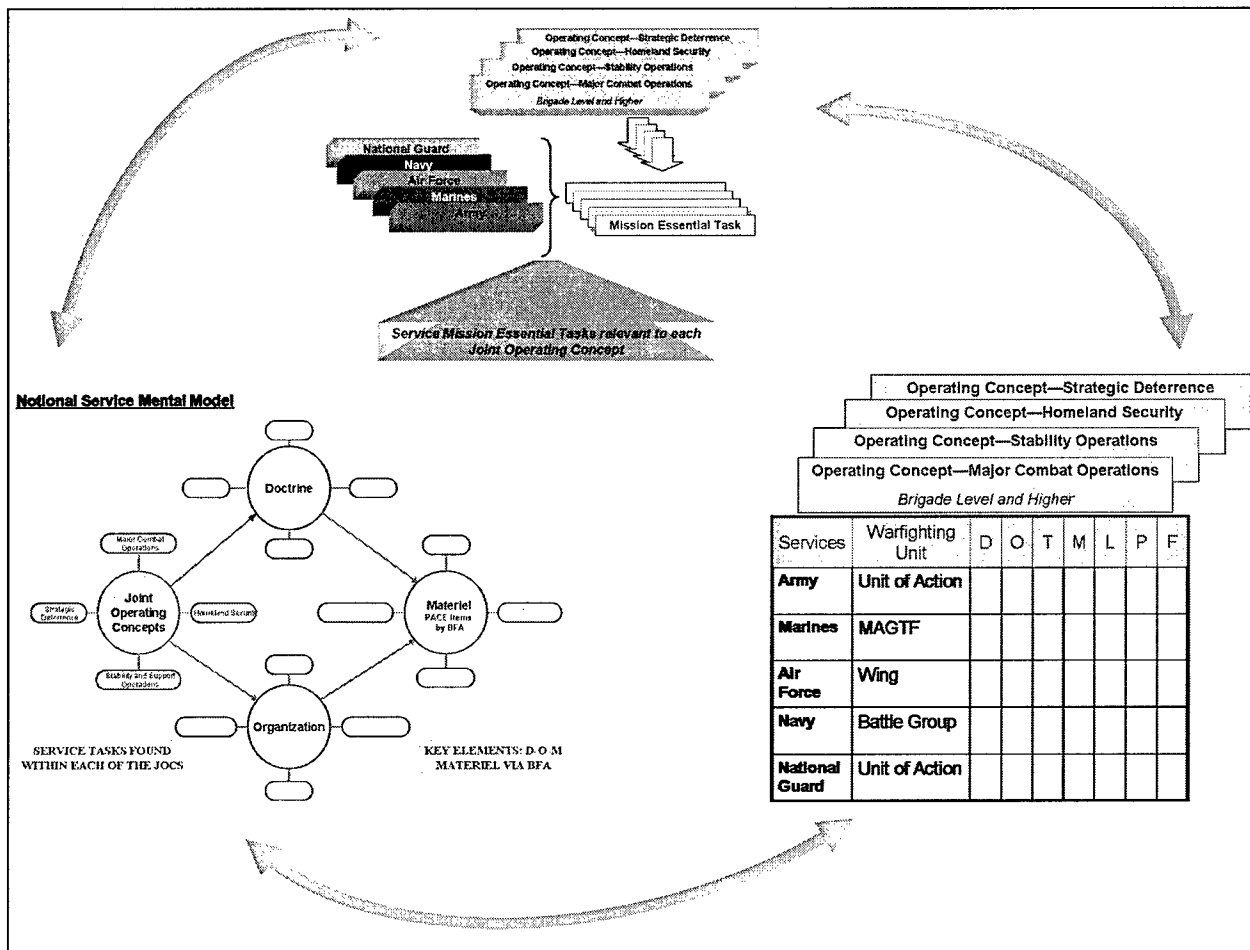


Figure 8: Front-End Analysis Construct Components Relationship.

4. Simulation-Based Training Literature Review

Simulation-based training can take on a variety of forms. The cost versus benefit of simulation is a function of the psychological and physical fidelity that designers attempt to incorporate into the simulation (Goldstein & Ford, 2002, p. 240). Psychological fidelity is “the extent to which trainees perceive training equipment as being a duplicate of the operational equipment and task situation,” according to Fink and Shriver (1978), who advocate selective fidelity. Patrick (1992) suggests that different types of simulation be used for different levels of proficiency when acquiring a skill, with simple representations of the equipment used for initial stages of skill acquisition. Goldstein notes that the design of training simulators can be quite expensive when designers attempt to be completely accurate in terms of physical engineering fidelity—the representation of the real world of operational equipment. It is important to determine what features should be included in simulation-based training. The reality, however, is that an adequately well thought-out, established, and published belief system of principles for features that should be included in training simulators does not yet exist.

Despite the critical nature of psychological fidelity, the question that remains is, how much physical representation is necessary to achieve psychological fidelity? For example, is a simulation of motion a necessary aspect of pilot training? Research has begun to provide some answers to the balancing of physical and psychological issues. Past simulators have been found to be quite effective when a critical behavior is the focus of the training effort (Goldstein, 2004).

Objective human performance constructs and metrics must be identified to address simulation fidelity. With the absence of any such metrics, the Army must rely on simulation contractors to determine appropriate levels of simulation fidelity, which may stem beyond the point of diminishing returns. Miller’s hypothetical relationship between simulator fidelity, training transfer, and simulator cost has been widely cited (Miller, 1954). The transfer of training function initially rises steeply and then levels off as physical fidelity increases. In contrast, the cost of simulation initially rises slowly but any increase between medium and high fidelity is associated with a large increment in cost. Miller suggests that there is a point of diminishing returns that represents the highest transfer to cost ratio, i.e., where the two curves are furthest apart.

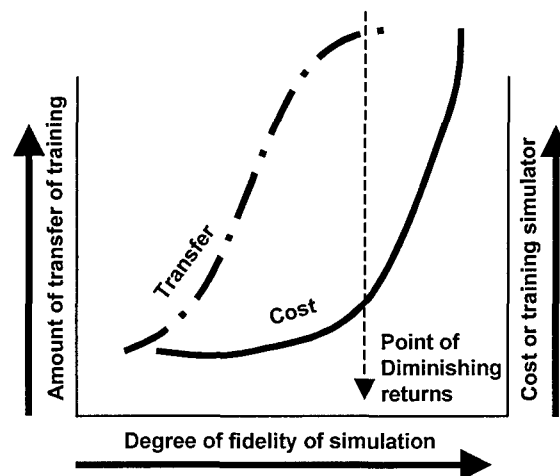


Figure 9: Miller’s Hypothetical Relationship Between Simulator Fidelity, Training Transfer and Simulator Cost (Miller, 1954).

Training scientists and practitioners alike have begun to focus more on determining when and why training programs succeed or fail (Mathieu, Tannenbaum & Salas, 1992). This issue becomes particularly crucial with the development of simulation-based immersive technologies and the expense of development.

4.1. Fidelity

As introduced above, an important issue in simulator training is the degree of realism or fidelity of the simulator to its counterpart in the real world. High fidelity simulators are usually quite expensive (Wickens, et al 2004). Miller (1954) attempted to describe relationships between simulation fidelity and training cost. At both extremely low and extremely high levels of fidelity, little transfer value can be gained with incremental increases in fidelity. At moderate levels of fidelity, however, large transfer gains can be made from small increments in fidelity. Changes in the requirements of training should thus be accompanied by corresponding changes in the degree of fidelity in simulation to provide adequate and efficient transfer. To optimize the relationship between fidelity, transfer, and cost, one must first identify the amount of fidelity of simulation required to obtain large amount of transfer and the point where additional increments of transfer are not worth the added costs. The critical question is what factors produce the greatest transfer of training and how best to represent them.

For manual tasks, a model developed by Kinkade and Wheaton (1972) distinguishes among three components of simulation fidelity: equipment fidelity, environmental fidelity, and psychological fidelity. Equipment fidelity refers to the degree to which a training device duplicates the appearance and feel of the operational equipment. Environmental fidelity refers to the degree to which a training device duplicates the sensory simulation received from the task situation. Psychological fidelity addresses the degree to which the trainee perceives the training device as being a duplicate of the operational equipment and of the task situation. There are three principal stages of learning, and different stages of fidelity are needed at different stages of learning. In the early stage, procedures training, little benefit can be gained from high environmental and equipment fidelity. In the next stage, familiarization, trainees are acquiring skill and benefit from higher levels of equipment and environmental fidelity. During the final stage, skill training, fidelity requirements continue to increase.

The relationship between degree of fidelity and amount of transfer varies based on instructor ability, instructional techniques, types of simulators, student time on trainers, and measurement techniques (Hays and Singer, 1988). The major problem is that although the goal of training is to improve job performance, the engineering decisions in training system development are often made without that goal in mind (Hays and Singer, 1988, p.19). Alessi (1988) proposed that fidelity effects depend on the instructional level of the learner, and as students' progress they will benefit from increasing fidelity. He suggested that the relationship between training fidelity and learning followed a pattern similar to the inverted-U relationship between stress and performance. Increasing fidelity continually facilitates learning until saturation is reached, and then increases start to degrade learning.

Logan (1988b) proposed the instance memory theory, which provides a contemporary cognitive-based justification of the high-fidelity approach. According to this theory, each experience with an event establishes an episodic memory trace. As the number of stored traces for a specific behavioral activity increases, performance becomes more skilled because there is a likelihood of quickly retrieving an appropriate trace. Thus, training situations should be as similar as possible to the real world environment. Using high fidelity simulators is one tool that can be used to replicate the work environment.

The importance of fidelity in a training simulator cannot be understated when designing an effective training simulator. The impact of cost verses transfer must always be at the forefront during design. Before the issue of fidelity can be addressed, first a clear, current definition must be established. According to the Royal Naval School of Educational Training Technology (2001) there exist three separate criteria for measuring the fidelity of a training system, including:

1. Physical – Spatial, tactile and appearance

2. Functional – Format, content and response
3. Environmental – Sound, motion and ambience

Once the purpose of the simulator has been established, it becomes possible to determine the appropriate degree of fidelity for each of the three criteria (physical, functional, environmental) of the simulator itself. The overriding principle of the training simulator should be the ability to provide positive (constructive) training. If the simulator does not have this attribute, then the design, development, and implementation of the simulator itself is, at the very least, ineffective, which is sometimes referred to as neutral training. Additionally, one possible detrimental aspect of training simulators is the potential to provide negative (destructive) training. Positive, neutral, and negative training are defined by Lever (2004) as:

Positive Training – A process in which knowledge, skills, and/or attitude are changed in such a way that when presented with the real task the student, if following what they have been taught, would carry out the process correctly.

Neutral Training – A process after which there is no change in the student's level of knowledge, skills, and attitudes to perform the task(s) being trained.

Negative Training – A process in which knowledge, skills, and/or attitude are changed in such a way that when presented with the real task the student, if following what they have been taught, would carry out the process incorrectly or, in the worst case, dangerously.

While it is possible that simulators with low degrees of fidelity may provide negative training, it is fallacious to think that only training simulators with the highest degree of fidelity can be an effective training tool. Lever (2004) states that one of the difficulties in introducing objectivity into the process of definition of fidelity levels in training simulations is that simulators are still seen as replacing training that previously would have been conducted on the real equipment. The perception is, therefore, that the simulation should be as close as possible to the "real thing" to successfully replace it. However, the real advantage of using simulation in training is that the real equipment is designed for real operations, whereas a training simulator can be designed specifically to meet the training need.

While every effort should be made to maximize the fidelity of any training simulator, there will always exist cost tradeoffs. What is important is that the simulator itself be designed in such a way to meet the specific needs of the training program. These needs are met by first determining the training and/or enabling objectives of the simulator itself. Once these have been established, the balancing of cost, fidelity, and training effectiveness specific to the particular program can be accomplished.

4.2. Task Retention

Retention, or durability of task knowledge, concerns the idea that most complex tasks are learned with the expectation that mastery will extend past an immediate acquisition point. In many cases, people who learn tasks expect to use the knowledge not only immediately or in the near future, but an appreciable amount of time following the point of mastery. For many everyday tasks, retention of task knowledge concerns a number of issues. Not only must the learner remember the behavioral components of the target task, but he or she must also retain the cognitive components of the target task. In some cases, the two components are evidently separated, such as a piano player who can play a piece of music flawlessly once a certain point is reached, but must be primed to reach that point.

Certain tasks are notorious for their ability to be resistant to decay. For example, motor tasks that are easy to recall are often compared to "riding a bicycle." On the other hand, some apparently simple tasks become difficult indeed after a relatively short time interval has passed. Examples may include procedural skills such as inserting pictures into word processed documents, playing a musical instrument,

or performing certain athletic activities. Wetzel, Konoske, and Montague (1983) noted these differences by explaining that motor skills are typically more resistant to decay than procedural skills.

In the realm of everyday tasks, people tend to take such decay for granted. However, there are a number of complex task domains where the notion of task retention is important or even critical. In such cases, failure to recall task details quickly becomes a concern rather than a casual inconvenience. In fact, lives may be at stake if a task operator forgets the details of task performance. One common example of such an environment is aviation. Because of the complexity of flying, there is a considerable potential for pilots to forget how to accomplish certain tasks. Commercial and air transport pilots are required to complete periodic refresher training and "check rides" to ensure that their skill base has not decayed. However, general aviation pilots are typically held to a lesser standard. This is troublesome given the tendency for such pilots to exercise their skills with reduced frequency. Accident databases such as the Aviation Safety Reporting System are replete with examples of mishaps attributable to loss of skills after a considerable retention interval.

Other task operators are similarly at risk for loss of skill mastery. Nuclear power operators, firefighters, and police officers encounter dangerous situations with varying frequency. Each category of task necessitates some level of refresher training to prevent decay of task mastery. However, whether the training is adequate in type and amount is debatable.

Military tasks are a particularly important example of a domain where task skill retention is crucial. Frequently, Soldiers who are dismounted or vehicle based learn complex skills that must be retained for some period until they are used. Simulation training has been touted as a method for providing refresher training to such personnel. O'Hara (1990) conducted research that examined the retention of simulation-trained skills. In that research, he noted that the patterns of skill acquisition during training and skill loss during retention periods often affect simulator trained skills as well as traditionally trained skills. Of special interest are military guard and reserve units, whose ability to practice and perform are constrained compared with regular military troops. For that reason, some researchers have focused specifically on them (Wells & Hagman, 1989).

Previous research has demonstrated that retention of task knowledge and cognitive skills can be quite good. However, the retention of psychomotor skills depends on a number of factors such as whether the task is continuous or discrete (Ellis, Wisher, Sabol & Ellis, 1999). A broad range of task domains have been studied to identify those aspects of a complex skill that resist decay over long periods of disuse. Such studies have found that retention greatly depends on the learning procedures that are employed (Bourne, Ericsson, & Healy, 1999). For example, Schaab and Moses (2001) noted that Soldiers often have difficulty retaining and transferring the skills necessary to operate digital weapons and equipment. The researchers found that training procedures that incorporated real-world scenarios promoted active problem solving strategies and improved skill acquisition, retention, and transfer.

One factor that influences degree of skill retention is degree of initial learning. Researchers agree that greater initial learning generally improves retention. Goldberg, Drillings, and Dressel (1981) showed that degree of learning of initial skill was a determinant of retention. In a study of M60 tank gunners, these authors showed that mastery training (ability to perform three successive correct gun boresighting and zeroing tasks) improved task retention after a five-week interval, compared with Soldiers who were taught to a lesser criterion (ability to perform only one correct task). Similarly, Schendel and Hagman (1980) found that greater initial practice also led to increased retention for Soldiers taught to assemble and disassemble an M60 machine gun.

There is also evidence to suggest that testing during training leads to greater retention. Specifically, if there is to be a lengthy period of no practice following initial training, Hagman and Rose (1983) suggest

that testing Soldiers during training will lead to greater retention. Other variations of practice may also be important. For example, Hagman and Rose note that there may indeed be a retention benefit associated with spacing practice sessions across time. However, that benefit is likely greatest when applied before task proficiency occurs. Furthermore, Wells and Hagman (1989) found that spaced practice particularly benefits verbal tasks.

There are also retention differences associated with individual selection. As noted by O'Hara (1990), personnel characteristics are particularly important indicators of task retention. In fact, Jones (1989) wrote an article in which he discussed individual differences in skill retention as a function of learning rate during acquisition. In that article, he noted that participants who experienced slowed skill acquisition late in practice were more likely to enjoy better skill retention. In another example of the importance of individual differences, Hagman and Rose (1983) reported that individuals higher in general ability seem to achieve better initial learning as well as better retention. However, those findings are complex and may vary according to the particular environment, task, and technology employed. Wells and Hagman (1989) offered other strategies for improving retention, such as offering refresher training, providing verbal descriptions of tasks, and using learning strategies such as mnemonics to assist with initial task mastery.

Healy, Clawson, McNamara, Marmie, and Schneider (1998) identified three classes of guidelines to optimize retention. The first class of guidelines concerned methods to improve training conditions. The authors recommended that tasks should be broken down into fixed predictable sequences, and training should focus on each sequence rather than the task as a whole. The second class of guidelines concerned ways to improve training strategies. The authors found training that promotes efficient encoding strategies maximizes long-term retention. Finally, the third class of guidelines concerned methods to achieve automatic retrieval from memory. Healy et al. found that automaticity generally requires extensive practice.

Emotional arousal may also improve retention. Ulate (2002) conducted a study in which he examined the impact of emotional arousal on recall of virtual environments. He established low and high arousal conditions using a first-person shooter videogame. Both conditions required participants to memorize objects that they encountered along a preplanned route. However, in the high-arousal condition, participants were required to fight enemy forces while navigating the route. Ulate found that participants in the high-arousal condition recalled more objects immediately following the task as well as 24 hours later.

In addition, training schedules can impact both task retention as well as transfer of training. In a study conducted by Hagman (1980) on Army fuel and electrical specialists, Soldiers who were given one-day rest periods between training task repetitions demonstrated better retention and transfer of skills compared to those who were not given periods of rest. Thus, Hagman concluded that spacing of task repetitions during training might be effective for improving both retention and transfer of skills.

4.3. Overview of Training Programs

According to Harper (1996) the primary concern of any type of training is the acquisition, transfer and retention of skills and knowledge. Many perspectives and theoretical approaches on the mechanisms underlying skill acquisition have been presented. The approaches begin with a hypothesis of how humans acquire skills and then outline a foundation upon which training should be based according to the hypothesized learning process. Harper (1996) discusses a few of these approaches:

4.3.1. Stimulus-Response Approach

Fitts and Posner (1967) developed a three-phase theory in which they considered skill acquisition to proceed in three distinct stages:

1. Cognitive phase in which the initial "intellectualization" process involved in learning a new task is examined.
2. Fixation or associative phase, in which corrected patterns of behavior are slowly established by practice with error being gradually eliminated.
3. Autonomous phase, in which skills become automatic and require fewer psychological resources such as memory and attention.

Fitts and Posner feel that this three-stage approach would effectively allow trainees to develop the skills necessary to complete any task that they faced.

4.3.2. Acceleration, Tuning, and Restructuring Approach

Rumelhart and Norman (1978) suggested that complex human learning occurs through the development or modification of a schema. These various schemata are the means by which information is represented in a person's knowledge base. In their approach, Rumelhart and Norman identified three types of learning: acceleration, tuning, and restructuring. Acceleration occurs when new information is encoded in terms of existing schemata. Tuning involves the modification of existing schemata, while restructuring refers to later stages of knowledge development in which a schema is refined in its application to specific situations.

4.3.3. Feedback Information

Feedback information research offers some surprising results of the long term effect on learning for either motor or cognitive activities. Types of feedback vary from intrinsic and extrinsic, concurrent and terminal, immediate and delayed, or separate and accumulated. Intrinsic feedback occurs automatically when the learner performs the task and sees the result right away, such as missing a catch. Extrinsic feedback comes from other individuals or embedded systems. It is concurrent if it occurs while the learning activity is being performed or terminal if it occurs at the conclusion of the training. Extrinsic feedback can also be immediate or delayed and, if delayed, can be either offered for each attempt or after a number of trials. The feedback itself can also vary from knowledge of results or knowledge of physical performance.

Salmoni, et al (1984) and Wheaton, et al (1976) offer thorough reviews of feedback and some interesting findings on when and how much feedback is appropriate. Schmidt (1988) found that if feedback is provided after each trial that immediate performance improves but there is no difference in effect on long-term performance compared to giving only summary feedback. Miller (1953) proposed that offering feedback concurrent with the learning task might serve as a crutch and be a disadvantage later if feedback is absent. The general consensus on feedback is that it should not provide too much too soon. Giving immediate and constant feedback may fail to optimize training; delayed and intermittent feedback may produce superior results because it allows learners to detect and self-correct errors and it diminishes reliance on extrinsic sources (Reder & Klatzky, 1994).

Feedback has commonly been used in many types of training programs. One of the most common uses of feedback is that of performance feedback. Performance feedback is where the subject is apprised of their performance after they have completed a task. Performance measures such as time and number of errors detected or missed has shown the greatest improvement in performance on a visual search task (Gramopadhye, Drury, and Sharit, 1997).

Other types of feedback, such as cognitive feedback that consisted of representations of the path and coverage of the search sequence, have also shown improvement in search performance (Gramopadhye, et

al, 1997). Deane, Hammond, and Summers (1972) found that cognitive feedback resulted in a better understanding of the task characteristics and improved control performance by participants over the execution of their knowledge. Cognitive feedback consists primarily of three feedback modes in which information can be given to participants. They are auditory cognitive feedback, statistical cognitive feedback, and graphical cognitive feedback (Nair, 2002).

Because feedback has been consistently shown to improve inspection speed and accuracy, provided it is given in a timely and appropriate manner (Gramopadhye, Melloy, Gopinath, and Budgavi, 1997), researching what types and how to present feedback has been the focus of many researchers for the past several years. Research has shown that feedback to inspectors regarding their performance can be advantageous in multiple fault inspection tasks (McKernan, 1989). The number of faults an inspector searches for frequently exceeds 50 (McKernan, 1989). Because of this fact, inspectors usually concentrate on a subset of faults that include the more probable, the more conspicuous, or the more important from a cost and safety viewpoint. In a study by Gramopadhye et al, 1997, which provided economic feedback associated with the inspection process, it was found that subjects not only demonstrated similar improvement to performance feedback but also approached economically optimal trade-offs between speed and accuracy. In the context of airframe structural inspection, a study performed by Gramopadhye et al (1997) found that graphical feedback on the scanning pattern showed the best combined response in performance and strategy. The subjects' speed improved without affecting their error rate. They also evolved a combination of efficiency improvements (fewer viewer fixations, shorter inter-fixation distances, less overlap) which did not compromise coverage. The use of feedback training under appropriate noise conditions (such as those found in an industry setting) has also been shown to have the greatest transfer effect when compared to other training conditions (Gramopadhye and Wilson, 1996).

4.3.4. Feed Forward Information

The use of feed forward or prior information has been shown to increase performance of inspectors. Prior knowledge or information consists of the concepts, goals, rules, and other information already stored in memory about a particular topic. One example of feed forward information is the use of past experience; subjects (inspectors) typically concentrate their search on a subset of the more probable faults types. Other examples of feed forward information may include issuing information about lot quality, probable defect location, and criticality of defects. Sheehan and Drury (1971) found that informing an inspector which defect would be present before each inspection trial greatly improved inspection performance. Evaluation using signal detection theory showed the prior information had caused the inspector's detects ability to increase, thereby increasing the number of correct rejections.

The way that inspectors use feed forward information is not uniform. It varies from inspector to inspector. McKernan (1989) suggests that inspectors may 1) ignore the information completely, 2) selectively incorporate only some of the information, or 3) incorporate the information only after gaining verification from the initial inspection segments.

McKernan (1989) suggests that experienced inspectors may make use of feed forward information in a way that complements their sensitivity to the fault. If the fault is one that is not easily detected by the inspector, he/she will rely heavily on the information provided. West (1981) also came to the same notion. His results indicate that inspectors will use prior information in situations that are ambiguous. If an inspector is unsure of what to expect, he/she will adjust search time based on the prior information.

Ernst and Yovits (1972) propose that the information contained within the source must serve the needs and the uses of the decision maker. If the inspector does not need the information (i.e., if he/she is doing well enough without it) he/she will not use it. The prior information will not help search performance.

Results seem to indicate that inspectors use the information where they need assistance in the inspection task and when they are able to add it to their memory load.

Though inspectors might not use feed forward information, the use of excessive prior information may in fact reduce the inspector performance in a visual search task. When a relatively simple stimulus such as a tone or visual shape is repeatedly presented as irrelevant, it becomes difficult for that stimulus to enter into new associations (Lubow and Kaplan, 1997). The phenomenon, termed latent inhibition (LI), has recently received considerable attention in the literature.

A study by Zalstein-Orda and Lubow (1995) provides an example of LI. The procedure consisted of two phases: pre-exposure and test. In the pre-exposure phase, the participant was presented with the same meaningless shape in the context of a particular screen background for 80 trials. Concurrent with such presentations, a different trigram appeared within the shape on each trial. The participant was required to determine the number of times the list of trigrams repeated itself. The masking task, which produced the LI, served to divert the participant's attention from the shape stimuli. The masking stimuli continued to be present on each trial, but on any given trial either the pre-exposed shape or a novel shape might appear.

The respondent had to learn that a change in numerical value on a counter was associated with the presence of the previously irrelevant, pre-exposed stimulus. The stimulus pre-exposed group reached the learning criterion more slowly than did a group that was treated identically except for the absence of the pre-exposed shape in the first phase of the experiment, thereby demonstrating the LI effect.

Because excessive amount of feed forward information may be of no use to the inspector or may worsen performance, McKernan (1989) suggests there should exist an optimum amount of information which, when given to the inspector in the proper form, will allow him/her to make accurate judgments without having to interpret any extraneous information. It has been shown that prior information may increase lobe size, direct eye movement patterns, enhance conspicuity, and decrease human error.

One of the most effective tools in improving performance is training. The use of training has been shown to produce large and consistent individual and group differences between inspectors in a variety of domains (Gallwey, 1982). Controlled practice has been shown to improve performance in both search (Parkes and Rennocks, 1971) and decision (Embrey, 1979) aspects of training. Kundel and LaFollette (1972) also showed that experience in inspection also affects inspection performance. However, experience in inspection is not the same as training (Drury and Kleiner, 1993); a training program can make substantial improvements, bringing novices to a performance level beyond that of experienced workers in days rather than months or years (Gramopadhye, Drury and Prabhu, 1997). Table 6 (Czaja, 1981), gives a summary of Practical Applications of Inspector Training Programs.

Investigator(s)	Training Techniques	Type of Task	Results
Tiffin, J. and Rodgers, H.B. (1941)	Knowledge of results (K of R) and training sessions which included lectures and demonstrations	Inspection of tin plates	General improvement in inspection performance: greater detection of faults
Evans (1951)	30 min class instruction; 11 tests with K of R over 2 weeks	Micrometer inspection of gage blocks	50% reduction in average error, but no effect on retention

Martineck, H., and Sadacca, R. (1965)	Knowledge of results using an error key	Photo interpretation	Decrease in error of commission
Chaney, F.B., and Teel, K.S. (1967)	Four, 1-h sessions which included lectures demonstrations, and K of R from a question and answer period	Inspection of machine parts	Training resulted in a 32% increase in defects detected
Cockrell, J.T. and Sadacca, R. (1971)	Knowledge of results and group discussion	Photo interpretation	Significant improvement in inspection performance and a decrease in false alarms
Parker, G.C., and Perry, G. (1972)	Demonstrations, use of photographs simulating items and faults examples of faulty items, practice with K of R	Inspection of glass bowls	50% increase in faulty detection, 50% increase in false rejections
Duncan, K.D., and Gray, M.J.(1975)	Gradual approach to the task (diagnosis of faults then verification) using programmed instruction	Fault detection in a petroleum refinery process	Training resulted in an increase in faults detected, decrease in detection time, and decrease in false rejections.

Table 6: Summary Table of Inspector Training Programs.

According to Gramopadhye et. al. (1997), seven training methods have been proposed for inspection, including:

1. Pretraining: Pretraining provides the trainee with information concerning the objectives and scope of the training program.
2. Knowledge of results, both performance and cognitive: Performance feedback for inspection typically consists of information on search times, search errors, and decision errors.
3. Feed forward or guidance: Feed forward information can take different forms such as physical guidance, demonstrations, and verbal guidance.
4. Part task and whole task training: Part task training constitutes partitioning or simplifying the whole task and then teaching these parts to the trainee.
5. Adaptive Training: Adaptive training tries to accommodate the different individual characteristics of the trainees.
6. Active Training: The trainee makes an active response after each piece of new material is presented (e.g. naming a fault).
7. Schema Training: The key to the development of schema is to expose the trainee to controlled variability in training.

Each of the preceding training methods has specific benefits associated with them. Before an appropriate method can be chosen, an understanding of the task must be obtained. This understanding will define how the training program will be developed and what interventions should be made. According to Gramopadhye, et al (1997), the training program begins with a thorough analysis of the requirements and needs (goals) of the training program. The next step is to establish the training group and identify the trainers and participants who will be involved. Following this, a detailed task analysis of the job is conducted to determine knowledge, skills, and abilities necessary for the job in order to specify the behavioral objectives of the training program. The final step is to define criteria measures against which inspectors will be trained and their performance measured. The performance measures allow different training methods to be evaluated in order to determine what training method is best suited for the inspection task.

Swezey (1983) outlines conditions of transfer in his Transfer Process Model for training simulators. These include task commonality, equipment similarity, learning deficit analysis, and training technique analysis. Simulator training for complex skills, motor or otherwise, offers a real opportunity for research that will contribute to an understanding of the learning process and training transfer (Goldstein, 2004). The investment of a high physical fidelity simulator may make it difficult to change and adapt to operational situations and combat system changes. For example, changing from peacekeeping operations to war or the upgrade of combat systems is an increasingly common instantiation of the need for this type of research. Capturing the essence of the psychological fidelity may be all that is required, which also lends itself more readily to modification in an ever-changing environment. Salas, et al (1998) report that a number of misconceptions, or invalid assumptions, exist in the simulation community that prevent scientists from fully exploiting and utilizing recent scientific advances in a number of related fields to further enhance aviation training. Salas relates these assumptions to over reliance on high-fidelity simulation and to the misuse of simulation to enhance learning of complex skills. Measuring training transfer and effectiveness is critical for measuring the utility of simulators.

Task Commonality	Whether the device permits the trainee to practice skills required for actual performance on the real task.
Equipment Similarity	The extent to which the equipment involves physically identical equipment and has identical information requirements.
Learning Deficit Analysis	An examination of the task to determine its relationship to the input repertoire of trainees and the difficulty level of training to necessary skills and knowledge.
Training Technique Analysis	An estimate of the instructional effectiveness of the device based on the degree to which relevant principles of learning are used.

Table 7: Parameters of Transfer Process Model.

4.4. Pre-Training Characteristics

Individual characteristics are pre-training variables that the trainee brings into the simulation-training program. These might include characteristics such as cognitive ability, physical ability, expectations, meta-cognitive skills & attitudes, personality, and self-efficacy. For the purpose of the proposed project, the focus will emphasize emerging and needed research in these areas. Table 8 summarizes research on pre-training characteristics.

Cognitive Ability	General intellectual ability going into the training has been examined in relation to trainee motivation	Tannenbaum, et al, 1991; Baldwin, et al, 1991
Physical Ability	Dexterity and sensorial factors that impinge	Hogan & Hogan, 1985

	upon the training transfer yet have little to do with the level of fidelity in the simulator	
Expectations	The perceived outcome that the training will have on the job	Martocchio, 1992; Hicks & Klimoski, 1987; Vroom, 1964
Meta-cognitive Skills & Attitudes	The combination of cognitions over a given time and the choices the trainee makes during the simulation training and influence on recall of information and intellectual skills relevant to the targeted actions and learning.	Noe & Schmidt, 1986; Gagne & Briggs, 1974
Personality	Factors such as Introversion/Extroversion, Neuroticism, Conscientiousness, Openness to Experience, and Agreeableness have been studied in relation to training in general but not to simulation based training. Most recently, newly identified personality factors such as "succorance", independence, and methodicalness may also influence training success.	Hogan, Arenson, & Salas, 1987; Jackson, et al, 2004
Self-Efficacy	The belief in one's ability to perform a specific task	Gist, et. al, 1989

Table 8: Summary Table of Pre-Training Characteristics.

4.5. Virtual Reality as a Simulated Training Environment Feature

With the recent advancements in technology it seems only natural that technology should be able to aid in the training of inspection tasks and/or other competencies necessary for today's asymmetrical warfare and in a period of stability and reconstructive operations. For years, computers have offered potential to aide in training operators in various inspection/training tasks. This has especially been the case with advancements in computational power and graphical displays capable of displaying high-resolution images and millions of colors. However, most of the previous attempts have been limited by the fact that images displayed on computer displays are two-dimensional in nature and do not create an immersive environment for the inspectors. In order to simulate "real-world" inspection tasks, it is necessary to create an artificial environment that mimics actual inspection/training tasks as close as possible. The question is, can technology be used to overcome current limitations in simulating inspection/training environments?

4.6. Virtual Reality in Education and Training

As aforementioned, various training techniques have been introduced over the years. Each training method has distinct advantages and disadvantages. Because VR is a relatively new technology and because equipment required to conduct VR experiments is prohibitively expensive there has not been much research to determine its effectiveness. Various studies have been conducted over the last decade pertaining to VR; however, because advancements in computers are constantly taking place, those studies may or may not reflect the effectiveness of VR training programs on recent computer systems. A decade ago the practicality of VR training systems seemed grim. Computer power was a major issue. Because the computer must constantly recalculate the entire graphics scene, computers were only able to display simple, parallel, and perpendicular images. A spokesperson for IBM stated that a typical misconception was that "you can have photographic quality in the scene" (Stevens, 1993). Today computing power is no longer an issue; digital photographs are commonly used in VR environments. Though the practicality of

VR training may now just be beginning to surface, since its inception one of the main purposes of VR was to act as a training tool.

Though VR training programs offer much promise, they do not come without disadvantages. One disadvantage that has received considerable attention is a phenomenon known as "cyber-sickness." Symptoms are similar to motion sickness and include headaches, nausea, sweating, and fatigue. Even days after using virtual reality equipment, things may suddenly appear unreal or unfamiliar. Eyestrain, joint injury from wearing the heavy equipment, and addiction to the virtual world are other possible health risks (Mueller, 2002). Aside from physical or psychological effects, the actual effectiveness of the VR environments is affected by many factors. One of these factors is "how real the VR environment is." A common way to interpret this is by asking if the environment is immersive, or does the subject feel as though they are in the actual environment. As VR systems become more sophisticated, the level of immersion in VR environments will increase. However, as noted in a study by Kass and Ahlers (1998), no matter how sophisticated the environments get, not all VR technologies are suitable for training all skills.

VR training programs may have limitations, but they also offer many advantages not found in other training methods. Also, given the appropriate VR system in conjunction with the appropriate training program, VR has proven to be an effective training tool. In a report to the National Science Foundation (NSF), Furness Winn and Yu (1997) discuss the various attributes of VR with respect to learning and put a special focus on the potential benefits of using VR in teaching the multifaceted issue of global change. They state as a general principle that "VR improves learning, when it does, by providing the learners with new, direct experiences of phenomena they could not have experienced before, either in direct interaction with the real world or using other technologies." Among the other principles that apply to VR in the context of education, Furness et al. (1997) suggested that VR is engaging and seductive, and it can teach complex topics with less need to simplify them. In a VR/VE (Virtual Environment), learners can easily and without effort visit places and view objects from different points of view, and can experiment by manipulating variables that cannot be manipulated in the real world (Yair, Mintz, and Litvak, 2001). Because of these advantages, VR offers the potential of being an excellent training tool in various fields, one of which is complex technical environments.

Complex technical environments depend heavily on properly trained operators for a multitude of systems, but are often associated with high on-site training costs and safety hazards that tend to make training sessions difficult or impossible, and thereby less frequent and available to fewer individuals. When training is improper or insufficient, damage and injury to both equipment and personnel are a very real threat, ultimately impacting costs, operational efficiency, and the quality of the working environment (Tam, Badrd, Marceau, Marin, Malowany, 1999).

The importance of improving training systems has driven the application of virtual reality in diverse areas (Bowman, 1995; Stytz, 1996; Cameron, 1996). While actual implementations may use varying degrees of immersion, they provide experiential preparation for the user by presenting direct "first-person point-of-view" interaction with a close approximation of the actual task environment (Tam et al., 1996).

4.7. Training Delivery System

Having identified the training methods to be used for improving cognitive components of leadership the next step is to identify the specific training delivery system to be used. Training delivery systems can be classified as Classroom Training, On-the-Job Training, and Computer-based Training (Gramopadhye et al, 1997). Gordon (1994) goes on to develop a more detailed taxonomy of delivery systems, listing the advantages and disadvantages of each training delivery system. The choice of the specific delivery system depends on various factors, some of which include the nature of the task, the type of knowledge

that needs to be transferred, user background and experience, implementation and developmental costs, time available, consequence of errors and flexibility.

Many types of industry rely heavily on training programs in order to ensure "new" employees will have adequate training before being introduced in the actual work environment. Industry often necessitates that training programs are very efficient in order to ensure that costs and training times are maintained to a minimum. Though industry often knows these time and money constraints, it still may be very difficult to develop training programs, which minimize time and financial investments while maximizing the return on these investments. Therefore industry often utilizes what training programs have been used in the past.

Many industries utilize on-the-job training (OJT); this training method does have advantages that may not be found in other training programs. On-the-job training is an informal way to teach individuals how to accomplish a task. It allows the trainee to learn skills while actually working on the job. OJT is said to be opportunistic since training may be delivered to an individual from a supervisor, a more experienced co-worker, or by discovery (McCord, 1987). According to Maddox and Parker (1995), OJT is the major means of training in the aviation maintenance environment. Though there are many advantages to employing OJT (i.e., low cost, easy to implement and flexible), care must be exercised to avoid the major disadvantages (Kraus, 1996). These include: (1) training may depend on people unskilled in instruction and therefore training may be haphazard and incomplete, (2) trainees may get very little feedback and as such may learn improper or incorrect procedures, and (3) occasionally, the trainee will assume a passive role and may not actively participate while learning a skill (Gordon, 1994). Also, because OJT does not control what scenario the trainees may find themselves in, it is often difficult to ascertain at what rate the inspector will be trained and to determine the effectiveness of the training. OJT often forces competent personnel that are performing other tasks to pause and guide the trainee through the appropriate procedures. This reduces efficiency of both the trainee and trainer and thereby increases the cost to the company.

An offline training program specifically designed for the experience level of a particular group may provide adequate training and a measure to ensure that trainees are competent before entering into the actual workforce. These training programs have been implemented in many types of industry and are often referred to as classroom training. In spite of the recent advancements in technology within the area of training, it has been estimated that more than 95 percent of training is still conducted in classrooms (Broadwell, 1987). Much of this can be attributed to convention, but other reasons include:

1. Ease of operation – most any room can be set up to provide training
2. Everyone starts and stops at the same time, and receives the same training
3. There is flexibility in that people can work in small groups, individually or as a total class (Kraus, 1996).

Classroom training (CT) has advantages not available to OJT such as the ability to develop a comprehensive training program that is not dependent on what is currently available "in the shop." Also, CT allows for best and worst case scenarios that may be unlikely or occur on a regular basis. This training can ensure the trainee is exposed to all known scenarios no matter how unlikely they may be. Another advantage of CT is use of instructor feedback, as usually an expert in the field performs CT and the trainees or students have immediate access to this esoteric information. The information may be used to immediately correct any mistakes made by the trainee. One more advantage CT has is the ability to evaluate the students or trainees. Because training is being conducted in a classroom environment, it is very easy to administer tests in order to assess how well the student/trainee comprehends what is being taught.

Classroom training is not without disadvantages, however. Gordon (1994) mentions some disadvantages to the traditional classroom training:

1. Though development cost may be low, expenses in providing an instructor may be high
2. Instructors typically follow an established program, and this may not allow for adaptation to individual needs
3. The traditional classroom training method tends to be passive, as most trainees listen without interaction or involvement in the material
4. Also, CT can often lack realism and lead to a false sense of trainee competence.

Computer-based training (CBT) has gained in popularity with the sudden ubiquity of software development tools and increasingly faster and more powerful computer systems. CBT is a generic term to describe a training delivery system that uses a computer to present the information/knowledge to the trainee. Generally, training is provided on a personal computer (PC) and is as such individualistic (Kraus, 1996). The advantages of CBT include (White, 1993):

1. It provides a systematic and consistent curriculum
2. It allows individuals to learn at their own pace
3. It can track the student's progress and provide immediate feedback to correct mistakes and improve performance
4. If there is interactively, this can motivate the trainee to learn
5. The curriculum is opened to observation, and can be updated as needed.

Earlier versions of CBT were linear and performed more like an electronic version of programmed text. As software and hardware developed, CBT not only presented instructional material, but also provided exercises and tests to reinforce learning and maintained a progress and performance summaries of each trainee (FAA, 1993). Many of the existing computer-based training systems still present information to the trainees with simple text and graphics images, but new technology, incorporating multimedia, is altering the way educators and trainers are developing training delivery systems. Multimedia is a powerful tool that gives the computer users random access to a variety of information and sensory experiences such as stereo sound, animation, full motion video, and a combination of the above (Gordon, 1994).

CBT also has advantages not available to other training methods. One of these advantages is the acquisition of the performance data exhibited by the trainee. With the use of computer systems it becomes very easy to determine the performance of an individual when performing an inspection task. The performance can often be accessed almost instantaneously either by the individual performing the task or by the instructor administering the task. This type of "feedback" can be an aid in instructing the trainee on any mistakes he or she may have made. CBT also offers the trainee the ability to progress at his or her own pace. This reduces any pressure of trying to "keep up" with other students, such as in a classroom-training environment, and allows the trainee to focus on mastering the task. CBT programs can also be used when the learner feels that he or she has time without having to wait for instructors to free up time in their schedule (Kearsley, 1987).

However, CBT is not without its disadvantages, because when CBT emulates actual scenarios it may be very costly to try to incorporate all possible outcomes into a CBT program. Also, a pure CBT program usually offers little interaction from an instructor in an attempt to guide the trainee. Though the trainee may be apprised of their performance, they may not know exactly how to correct what they are doing wrong. Another aspect that may be lacking in the use of CBT is that of realism; though the computational power of computers is ever increasing and computers can now easily display high-resolution graphics and even video, the trainee may not feel totally immersed in the training environment.

5. Example Exercises

The previous sections of this report show that: (i) mental modeling may be a crucial step in overcoming misconceptions and cultural baggage associated with each service command; (ii) tools for developing mental models and training in mental models are limited; and (iii) training involving a set of reference scenarios and associated vignettes based on tactical situations may be central for a cognitive leadership training system. Phase I research has developed unique tools for mental modeling research and Phase II training, and it has also provided integrated examples of implementing these models as part of cognitive leadership training.

5.1. Training Environment

The training environment was developed to incorporate both analytical tools and training exercises. The Training Environment software features a user-friendly interface, help files, and access to training materials. This software is highly integrated with the Mental Modeling software and other software platforms used for exercise vignettes (i.e. Decisive Action) via hyperlinks. Users can access mind-map libraries and charts during the training. The current version utilizes .NET technology. In Phase II, we plan to develop applications that implement Java-based algorithms that will make the educational software functional on multiple hardware platforms and easily deployable over the Internet. More details about the training environment and user guidance are provided as Appendix 1.

5.2. Approach to Developing Exercise Vignettes for Leadership Training

Serious games are those that are developed for purposes other than entertainment. They can be engaging and fun while requiring the player to use knowledge to succeed. They can also offer environments and situations that would be difficult to reproduce in real life, thereby pushing the boundaries of what can be taught as opposed to what must be experienced. While physical prowess is developed bodily, it is the mind that is exercised in serious gaming.

For many years, scientists have acknowledged the importance of simulator-based training systems (Vreuls & Obermayer, 1985). The ability to represent battle situations in a less-than-full fidelity situation is associated with higher degrees of control over the learning experience. Using simulators to represent battle conditions may allow trainers to present constant, graduated, or decreasing difficulty levels; conditions that mirror real-world scenarios; best- or worst-case scenarios; or a host of conditions requiring skills of the trainer's choosing. In most cases, simulation-based training has represented an alternative to real-world training that is cheaper, safer, and more controllable.

For all of its merits, however, simulation has been associated with certain drawbacks. Although simulation designers have made great strides toward implementing advanced graphics and interactive possibilities, the amount of money and talent at their disposal has not equaled the resources of proprietary game makers. Corporate game designers have the advantage of highly paid programmers, developers, and testers to ensure that their software is tailorable and effective, and that it represents the state of the art in terms of operability and usability.

Until recently, the worlds of military simulation and gaming have been fairly separate. However, military trainers have recently begun to examine common off-the-shelf (COTS) gaming technology to determine its usefulness for mission training (c.f., Wiebenga, 2005). In some cases, there is a leap to be made between the subject matter of the games and the mission parameters of battle. However, in the last decade the emphases of commercial games and of military training needs have begun to converge. As a result, modern games such as Command and Control: Generals represent modern warfare much more realistically than before.

Using COTS games as training tools is attractive from a motivational standpoint. Soldier trainees are liable to embrace such technology as realistic, engaging, and relevant. However, there are challenges to be met before such games can be considered a serious tool for training (Bowers & Jentsch, 2001). Scientists and trainers must become convinced that modern games offer the potential for adequate control of parameters such as mission difficulty, length, complexity, and teaming potential. The games must also provide sufficient means for data collection and analysis so that trainee performance can be gauged in a relative and absolute sense. Last, games must allow trainers to design situations that reflect current and future military doctrine, to enable (for example) interservice mission collaboration and collaboration / cooperation among various military units. Ultimately, to be effective, games should reflect and enable practice with all aspects of modern warfare: diplomatic, informational, military, and economic facets.

Adaptive thinking refers to effective response to changing circumstances. This idea presupposes that the circumstances will be novel and will require flexible decision making that does not detract or stray from the end goal. A cognitive skill such as this would be unusually suited to the gaming mode of instruction given its inherent need for the presentation of novel situations. While direct experience is always a preferred way to learn, sometimes it is not possible for a person to experience all possibilities before an adaptive skill is needed. The presentation of multiple scenarios in a game can better equip one to deal with a variety of situations that could occur in the future, rather than just those that mimic earlier experiences.

Consider for a moment Person A, who has lived through a rainstorm. He will know in the case of another rainstorm to use an umbrella. If told of an approaching hurricane for the first time, this person will remember his experience with rain and wind and still reach for his umbrella on the way out the door. Person B, on the other hand, has been presented with a rainstorm, a tornado, and a blizzard and played with response possibilities in a serious game. This person, having interacted virtually with multiple levels of weather conditions, understands the difference between a simple storm and more dangerous weather conditions. As a result, Person B may deduce that taking shelter is the best response to an oncoming hurricane in real life. While simplistic, this example shows the effect that virtual experience could have on adaptive thinking.

In the recent past there has been increased interest in the idea of using serious gaming to better train today's military. Much of this can be attributed to the success of the Army's most recent recruitment tool, the internet-based game *America's Army*. Since its release in 2002, *America's Army* has had over 5 million users, with over 1.34 billion missions played. Its developers hope that the game will result in increased recruitment and the retention of recruits following basic training.

While *America's Army* serves as entertainment, its real purpose is also education. This has been reflected in the rigorous efforts made to convey more realism than the average video game. For example, while in most first person shooter games one simply aims and fires, in *America's Army* one must deal with his own breathing rate, which affects his aim. This difference and others give *America's Army* a hybrid existence, entertainment but eerily close to real life. As a result, the game has sparked many training application considerations and is currently used by infantry Soldiers at Fort Benning before they engage in live exercise.

In addition to more realistic video experiences, *America's Army* also puts emphasis on the codes of conduct taught in the Army, again diverging from typical consumer video games. For example, one will gain more points in *America's Army* by helping a fellow Soldier than by leaving him to save one's own life. Courage and concern for the fellow Soldier would be the paramount lesson in this case.

A similar method of instruction could be used to reward adaptive thinking in these scenarios. An important difference between serious gaming and gaming entertainment is the means by which one wins the game. In gaming for entertainment, winning a skirmish may rely on the ability to press three buttons at once while holding down the left arrow; in a serious game situation, button pushing is not as important as the actual steps taken to win the skirmish. A curriculum for adaptive thinking would not seek to teach a person manual dexterity with a keyboard or controller, but rather to teach the way to make the best decisions in given situations.

The actions that depend upon these decisions would be the focus in a serious game for adaptive thinking. For example, after playing a serious game, questions to determine success could include:

- Were your actions in keeping with procedure?
- Did you act in a way that was detrimental to those around you, enemy or not?
- Did your actions take you closer to the end goal?

While gaming entertainment recognizes a win or a loss, a serious game for adaptive thinking would emphasize post performance evaluation and subsequent learning of yet another way to respond in a novel situation.

Additional advantages of serious gaming as a method of instruction include its relatively inexpensive cost when compared to live exercises. It can also be customizable to an instructor's needs. Additionally, it is portable and by its virtual nature it ensures that the player can encounter many different scenarios, offering the opportunity to encounter more situations than may be possible with traditional training. The seeming disadvantage of the lack of physical interaction might actually be an advantage, as students would benefit from the experience of multiple scenarios without getting hurt; cognitive, not physical, skills are the focus of this training.

The very nature of serious gaming appears to be a well-suited solution to teaching individuals how to think in a certain way. Today, the world is a different place than when classroom instruction was introduced. Serious gaming, with changing circumstances represented virtually and solutions found through the development of adaptive thinking, bridges the gap between classroom and live exercise.

5.3. Sample Mental Modeling Exercise

Figure 10 diagrams the Mental Modeling exercise developed as a part of the project. Other possible exercises are described in Appendix 2, along with a more thorough description of the program. The goal of the exercise is to visualize mental models for different commands and facilitate cross-cultural learning. The exercise features: (i) a library of mental models for different commands, (ii) the ability to draw mental maps, (iii) the ability to construct mental maps for a pre-defined object library, (iv) help files and multi-media examples, and (v) editable performance measures.

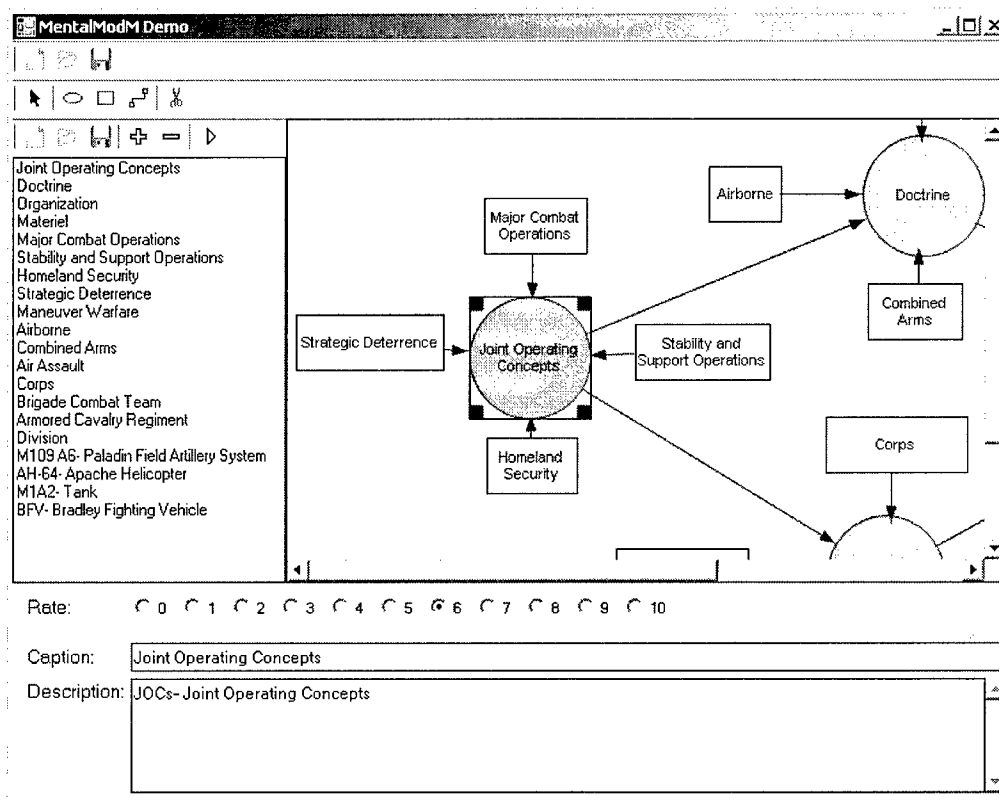


Figure 10: Mental Modeling Exercise Diagram.

5.4. Sample Gaming Platform Decisive Action for Training.

Scaled world platforms are frequently used in military research to provide complexity to experimental tasks that measure knowledge, skills, and abilities. These platforms allow greater focus on psychological fidelity, making them uniquely suited to measure cognitive skills such as decision making and adaptive thinking. Decisive Action™ is one example of an open-sourced game engine that allows for rapid scenario development and can be used to train individuals or groups of players.

Decisive Action allows leadership skills to be trained in a controlled environment. The proposed experimental setting is a scenario called Operation Mountain Strike, built on the Decisive Action computer game platform. It is loosely based on Operation Anaconda that took place in Afghanistan, and it shares many of the characteristics of a military command and control situation with the addition of Navy and Marine forces. The proposed scenario places the participant in a crisis situation as the commanding officer of a Joint Force operation. A crisis situation requires information from a wide range of information sources and categories, and the trainee, as the commander, has thirty minutes to assess the current situation with the information provided. The trainees will be assessed on how well they adapt to unforeseen circumstances that are introduced during the course of the experiment.

Serious gaming offers an interactive learning experience that is difficult to duplicate in traditional methods of learning, including the classroom and direct experience. With the non-physical nature of this approach, gaming is specifically suited to the teaching of cognitive skills. One skill for which serious gaming is especially suited is situation awareness and decision making under changing conditions or adaptive thinking. As a society that is becoming more technologically advanced each day, instruction and learning methods are evolving rapidly as well. Therefore, serious gaming becomes a logical next step in

teaching and reinforcing cognitive abilities and skills needed in a Joint leadership role where adaptive reasoning is an essential element of success.

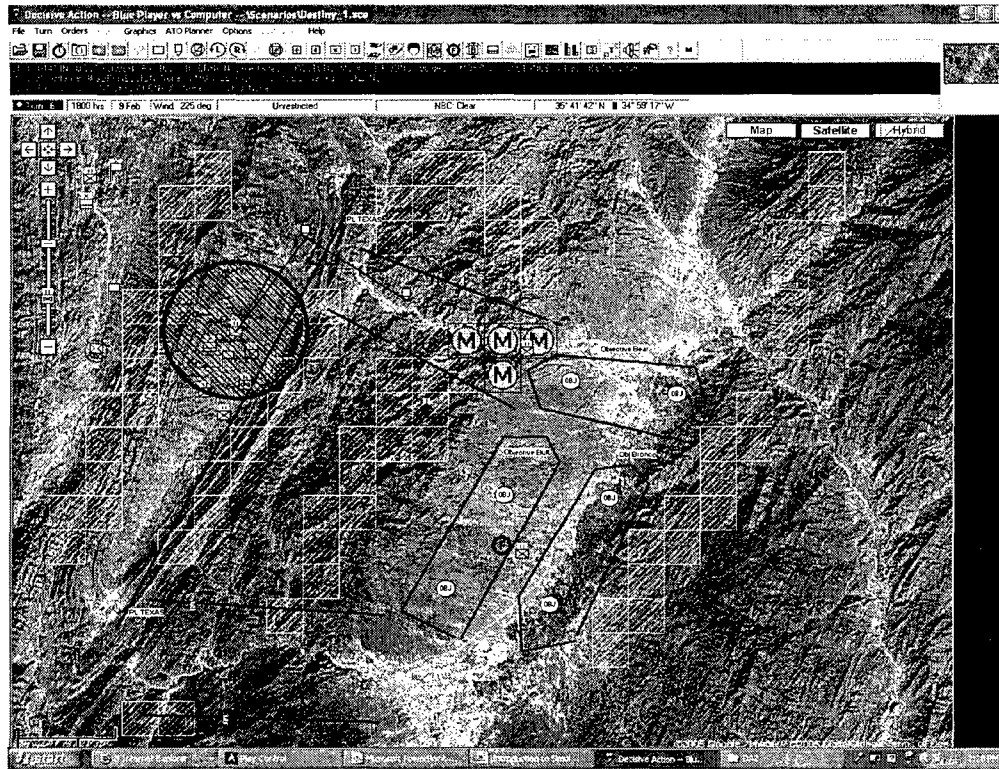


Figure 11: Decisive Action Game Engine Interface, with terrain and objective data based loosely on Operation Anaconda.

The main goal of the training is trying to grade or rank the Joint leadership adaptability of the participants when coming under unforeseen circumstances that involve unique issues encountered during Joint Force operations. In the proposed scenario, three “adaptive events” are utilized. These include a minefield that they are not able to identify until stumbling upon it, coming under sudden artillery fire, and encountering an ambush. All adaptive events occur based on the participants’ units coming in close proximity with the enemy’s units. Using the After Action Reports and Situation Reports that are available in this military version of Decisive Action, a subject matter expert grades the leadership adaptability of each participant. In the proposed training, mental maps or knowledge structures are assessed with the Card Sort Method. This is used as a basis for assessing the participants’ situational awareness relative to a Joint Leadership expert. For example, if a participant believes that the most important factor is “objectives” while another participant believes it to be “casualties,” and the participant who focuses on the objectives comes out with the better score, then it is possible to state that the participant who emphasized objectives possesses the correct mental model.

The scenario involves meeting three objectives while encountering three adapt events.

The adapt events (in rough chronological order) include:

1. Mine field
2. Ambush (1 ground unit)
3. Artillery fire

The following is an outline of the adaptive events and related parameters:

- 1) Mine Field
 - a) North mine field
 - i) Fly over (no detection of mine field)
 - ii) Detection of field – Avoid the field
 - (1) Follows Op Ord by moving along the border of route X & Z
 - (2) Disobey Op Ord by moving along areas outside of route X & Z
 - iii) Detection of field – did not avoid the field
 - (1) Breach Minefield
 - b) South mine field
 - i) Fly over (no detection of mine field)
 - ii) Detection of field – Avoid the field
 - (1) Follows Op Ord by moving along the border of route X & Z
 - (2) Disobey Op Ord by moving along areas outside of route X & Z
 - iii) Detection of field – did not avoid the field
 - (1) Breach Minefield
- 2) Ambush
 - a) Detection (no ground units in ambush area)
 - i) Detection through airstrike or coming in close proximity with the enemy unit
 - b) Response to contact with enemy ambush
 - i) Offensive action
 - (1) Airstrike
 - (2) Attack helo
 - (3) Air transport of troops
 - (4) Direct attack via ground movement
 - ii) Defensive action
 - (1) Retreat
 - (2) Movement to a fortified location
- 3) Artillery Fire
 - a) Detect specific artillery locations
 - i) Line of sight of a Blue unit provides persistent location information
 - ii) Airstrike on enemy artillery units provides temporary location information
 - b) Enemy artillery fire response
 - i) Known location
 - (1) Offensive action
 - (a) Airstrike
 - (b) Attack helo
 - (c) Air transport of troops in
 - (d) Advancing on ground
 - (2) Defensive action
 - (a) Retreat
 - (i) Ground movement
 - (ii) Air lifted out
 - (b) Movement to fortified area
 - (i) Fortification
 - (ii) Blue base or HQ
 - ii) Unknown location
 - (1) Scouting
 - (a) Random airstrike
 - (b) Attack helo orbits
 - (c) Ground movement/recon

- (2) Retreat
 - (a) Ground movement
 - (i) Retreat to stronghold
 - 1. Fortification
 - 2. Blue base or HQ
 - (ii) Movement to random location
 - (b) Air movement
 - (i) Retreat to stronghold
 - 1. Fortification
 - 2. Blue base or HQ
 - (ii) Movement to random location
- (3) No action

The figures below are examples of the Decisive Action user interface.

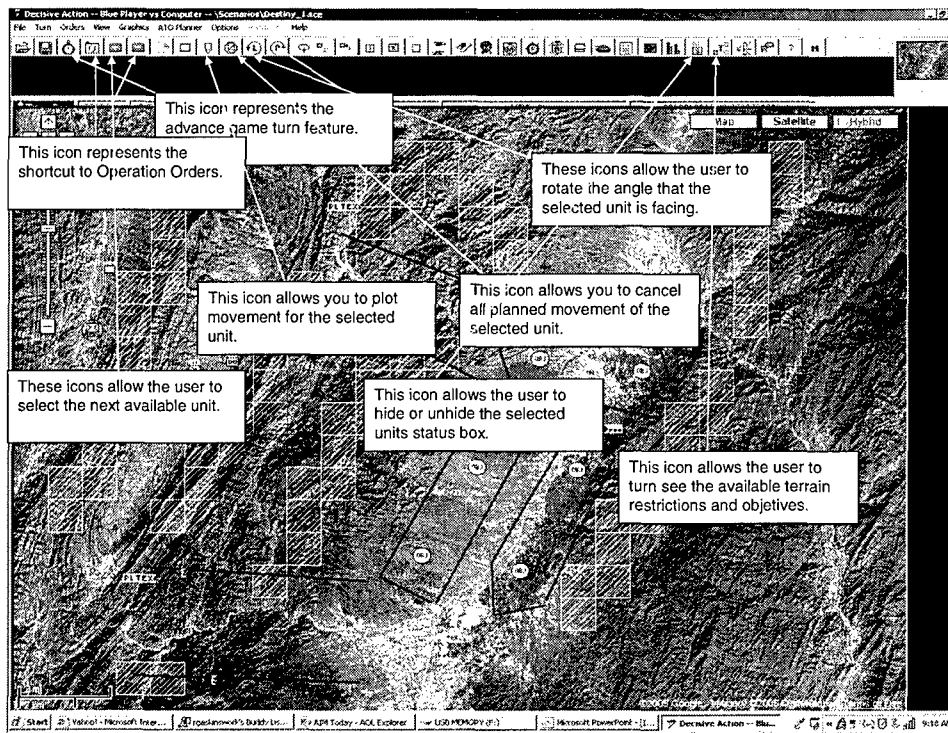


Figure 12: Decisive Action Features and Interface.

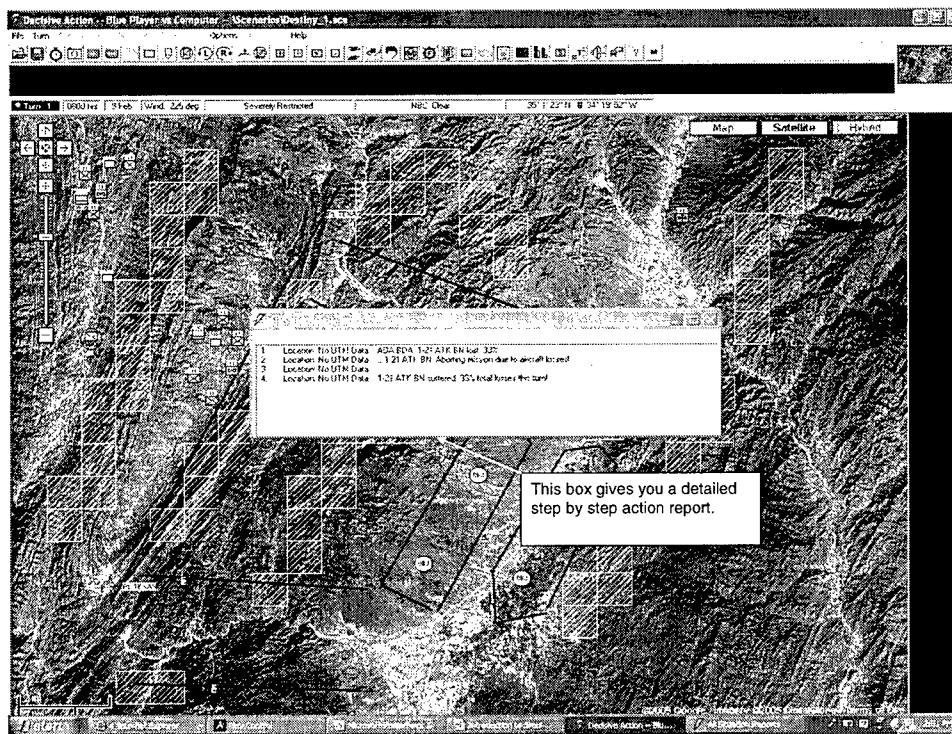


Figure 13: Decisive Action Features and Interface.

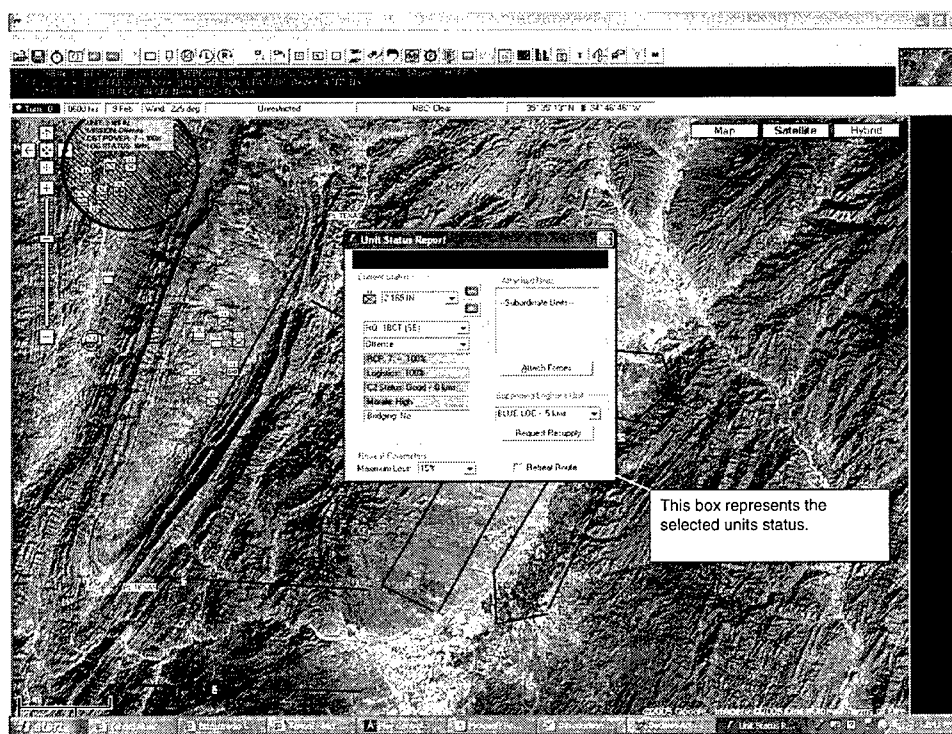


Figure 14: Decisive Action Features and Interface.

6. Performance Metrics

Figure 15 presents our approach for developing performance measures. Performance measures will assess the degree to which the JTF staff is able to think in the cultural mindset of the service organizations assigned to the JTF, much the way a bi-linguist must be able to think in the native tongue of the languages he has mastered. Performance measures will be developed as a part of the Phase II project. In developing performance metrics, we plan to capture whether the trainee:

- Articulates how a service organizes its forces for battle, and by extension, fights, sustains, reconstitutes, and trains as well;
- Understands the nature of battlefield functions from respective service perspectives;
- Appreciates and understands respective services' leadership approaches to mission accomplishment; and
- Is comfortable with the daily lexicon and acronyms familiar to respective service organizations.

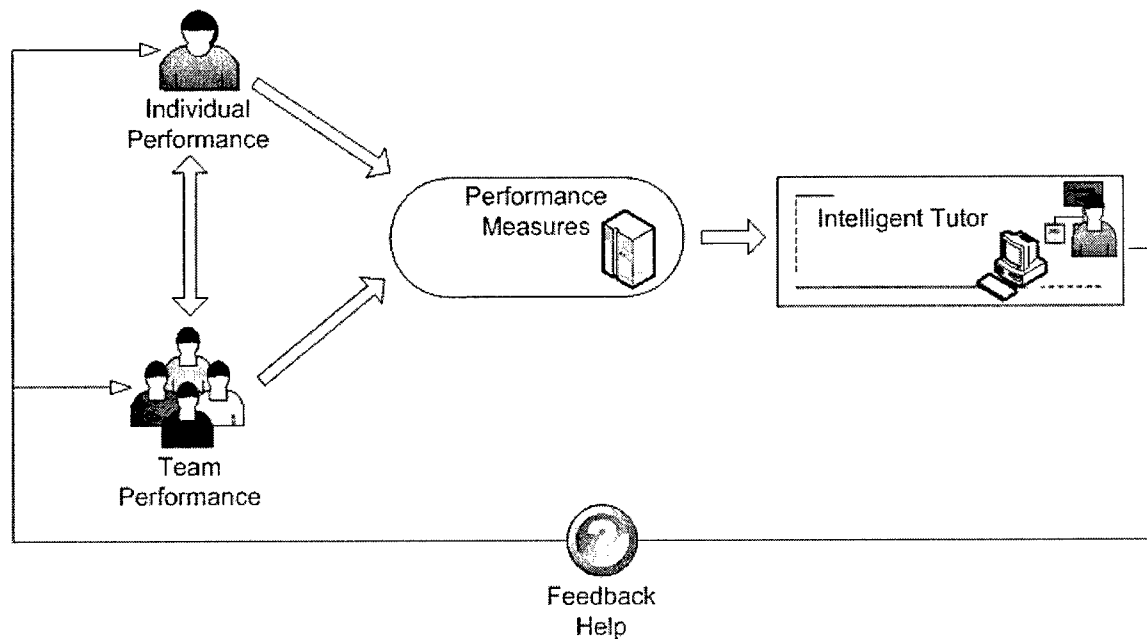


Figure 15: Automated Performance Measurement System.

A serious gaming approach will be employed and provide useful metrics of training effect based on the task performance and the overall performance. Such measures typically include scores for accomplishing individual objectives, time spent on objectives, errors in judgment, and transfer of training metrics such as job performance ratings and subjective measures of training utility. Additional measures of performance include reaction time, performance deterioration and performance variability, fatigue, and boredom. Measures of Joint leadership adaptability are derived from these and other performance metrics.

7. Relationship with Future Research or Research and Development

Possible future development of the proposed training software would include execution of the following tasks:

- **Develop Detailed Expert Model and Mental Models Protocol**
- **Conduct Mental Models Research and Provide Concrete Recommendations on Improvements**
- **Apply Research Results**
- **Develop Assessment Plan**
- **Develop Performance Measures for each Environment and Cognitive Attribute**
- **Evaluate JTF Training Package**

We would start with preparation of detailed expert models of joint capabilities, including Combat Arms, Combat Support, Combat Service Support, Reserve and National Guard components. A narrative to support the expert model would be developed. Based on experience, the expert model contemplated in this project would provide continuing value for the military as a comprehensive summary of technical information and views on important leadership characteristics and jointness training. The expert model would be capable of being updated as new information on the topics it addresses becomes available. This feature alone would help ensure long-term usefulness of the expert model and a good rate of return on investment into it.

Reconciliation of expert models with service representative perspectives would provide the basis for construction of the mental models for each service. Coupled with a structured approach to developing an interview sample, the mental models method could also help characterize communication networks at work in specific communities. In addition, the process of conducting mental models research has demonstrated that even participants who are skeptical of an organization often express satisfaction with a process that genuinely interacts with them.

The mental modeling portion of the plan would include real-time mental models interviews with individuals in appropriate samples to generate the insights required to evaluate joint capabilities understanding, using the expert models as the analytical framework for mental models research results. In Phase II of this project, we would conduct structured in-person interviews with dozens of current US military members of all services with recent experience in Joint Task Forces. The emphasis will be on, but not limited to, relevant experiences about differences in doctrine, organization, training and education, materiel, leadership and personnel. To our knowledge, this type of research has never been conducted on the topic of differences among particular service cultures in a Joint Task Force. The knowledge gained would be more accurate and timely than would be possible with other research methods. We would therefore be able to report more accurate findings and lessons learned from contemporary scenarios, and we would be able to incorporate those lessons into the model and simulation product we would develop. Additionally, because we would interview experienced members of multiple services, we would be able to appropriately apply the results to training in these individual services as well as within joint training and modeling and simulation efforts.

Results of Phase I and the shared mental models developed in Phase II will be used to drive the technical capabilities and substance of JTF Training software development. This project would support the development of training tools. An important aim is to provide empirical material to develop training materials for ground component officers and non-commissioned officers in a Joint Task Force. All results may be incorporated into existing and future training tools. For example, desk-top simulations or more

immersive environments leveraging virtual reality could be developed from the data in Phase II for use at Army training schools.

Assessment and evaluation plans would be developed and submitted for DOD approval in the beginning of Phase II. Phase II would include extensive evaluation of the JTF training package. In cooperation with DOD personnel, the project team would develop formative and summative evaluation (Scriven, 1991) plans. The formative evaluation would include systematic observation of students' work with the training package using a checklist to be developed by the team. It would also include questionnaire responses from students, addressing both their experience using the training package as well as their review of the content. Mental models and concept maps developed by the students would provide important feedback on student misconceptions and the acquisition of valid conceptions. The summative evaluation would utilize questionnaires modified from earlier experiences to indicate overall satisfaction with the student learning experience provided by the JTF training module, summary mental models, and student progress to assess authentic assessment of higher level achievement.

Appendix A

Mental Modeling and Training Software User Manual

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8.

Introduction

This manual describes Mental Modeling and Training software developed according to the framework of the **Computer-Mediated Training Tools to Enhance Joint Task Force Cognitive Leadership Skills** project by **Cambridge Environmental Inc** (Cambridge, USA).

Installation

System Requirements

This software package requires **Microsoft Windows 2000/XP**, **Microsoft Internet Explorer 6.0** or later, and **Microsoft .Net Framework 2.0** or later. If your software environment doesn't meet the requirements, please upgrade your system software. However, if your software environment meets most of the requirements but you do not have the **Microsoft .Net Framework** installed, you will be navigated to the **Microsoft .Net Framework** download page during the installation procedure. After downloading and installing the **Microsoft .Net Framework**, you will be able to complete installation of the software package.

If you have previously installed **MentalMod** or **MentalModM** software, please uninstall this software using the standard uninstallation routine: open **Control Panel**, open **Add or Remove Programs**, select **MentalMod** or **MentalModM** from the list of programs, and click the **Remove** button. After uninstallation is complete, you will be able to repeat installation of the software package.

Software Package Contents

The Mental Modeling and Training software is delivered as an installation package and includes the following files:

- **setup.exe** - executable module;
- **setup.msi** - windows installer package;
- **readme.txt** - installation instructions and system requirements.

The installed package includes:

- **Windows desktop** and **Start** menu shortcuts (by default: **Start->Programs->SSL**):
 - mental modeling software shortcut **MentalModM**;
 - training environment software shortcut **TrainingEnvironment**;
 - program folders and files (by default: **C:\Program Files\SSL\MentalModM**):
 - sample files folder **Samples**;
 - methodological and training materials folder **Cont**;
 - mental modeling software executable module **MCDMAApplication.exe**;
 - training environment software executable module **WindowsApplication1.exe**;
 - other required files: **App.ico**, **default.xml**, **MCDMControlLibrary.dll**.
-

Installation Routine

Before installing the Mental Modeling and Training software package, be sure that your software environment meets the requirements. Then, in the installation package, locate and run the executable file **setup.exe** and follow the onscreen instructions. The installation routine is developed as a wizard-based dialog and helps the user at each step of the software installation process.

The first step is invisible to the user and includes searching the computer for other (previously) installed versions of Mental Modeling and Training software. If previously installed software is found, an error message will be generated. Before installing the new version of the software package, please uninstall all previously installed versions of this software. Furthermore, at this stage the installation application looks for installed versions of the Microsoft .Net Framework. If a suitable version of this framework is not located on the computer, an error message containing a link to the download page will be generated. For additional information, see software requirements.

The second step is the appearance of the installation dialog. The first page of this dialog is an information page and includes copyright information. Please read this text carefully and then press the **Next** button to continue the installation process.

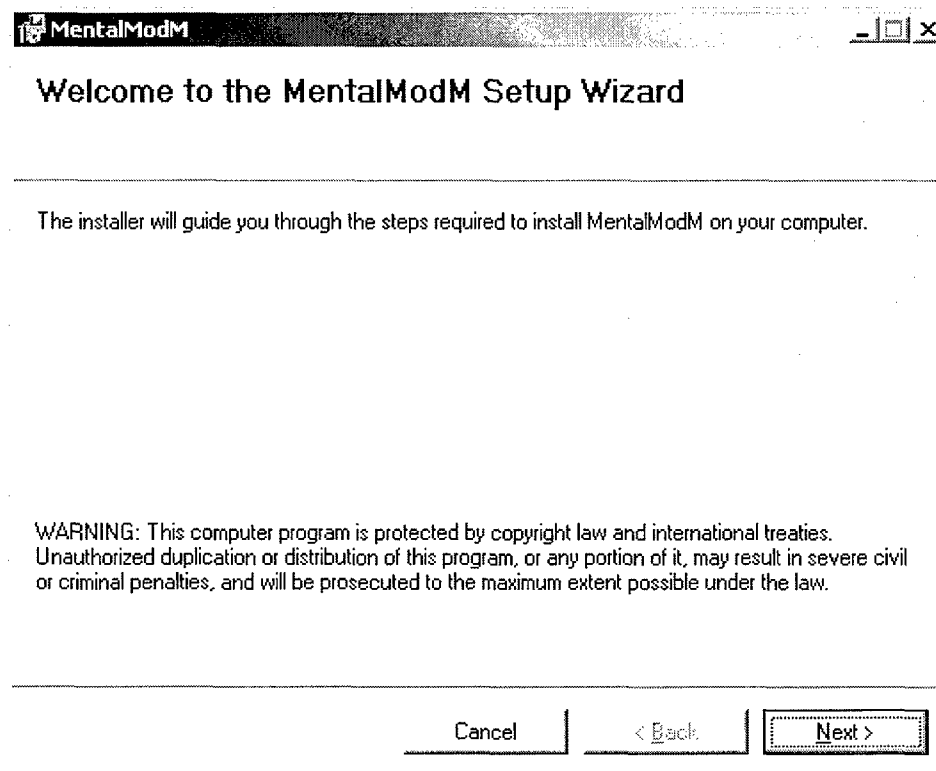


Fig. 1 The copyright page of the installation dialog

The third step in the installation process is the adjustment of installation parameters. It is not recommended, but you can change the installation folder and shortcut options.

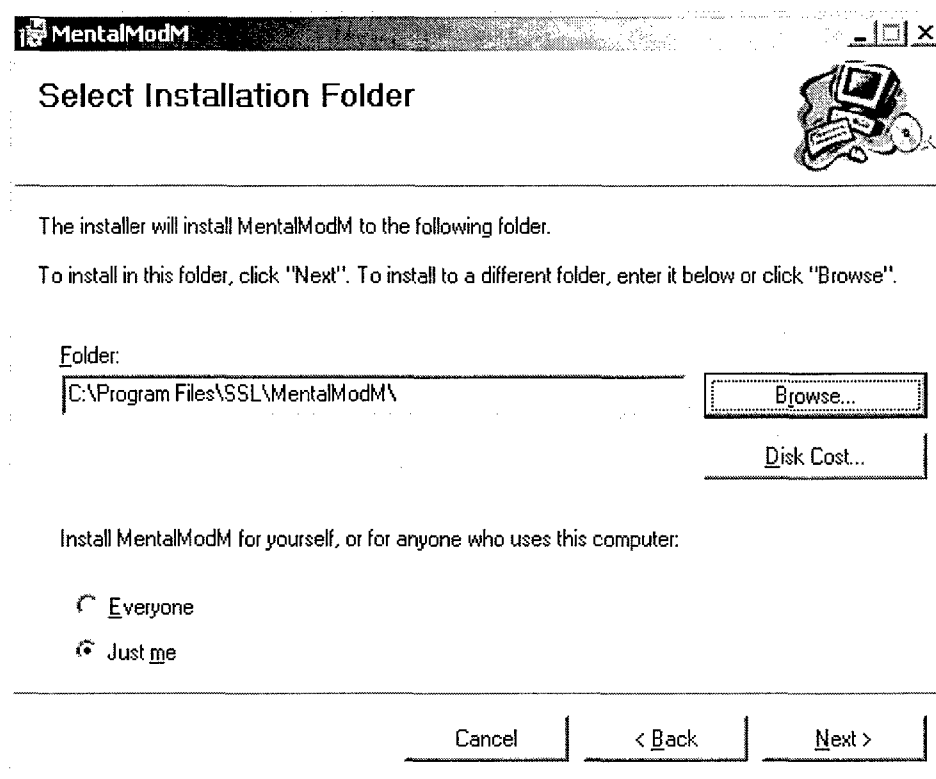


Fig. 2 The settings page of the installation dialog

The fourth step is confirming the software installation. At this stage the installation application is ready to install Mental Modeling and Training software on your computer. In order to install the software, click the **Next** button. To change installation settings, click the **Back** button; or, to cancel the installation process, click the **Cancel** button.

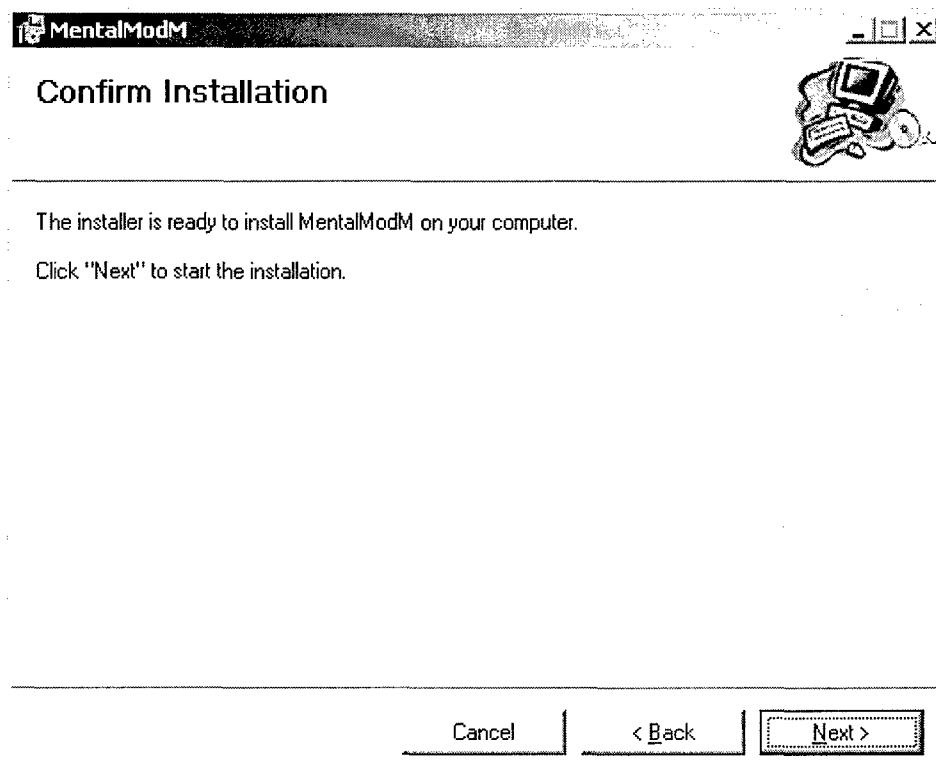


Fig. 3 The confirmation page of the installation dialog

The fifth step is the actual installation of the software. This step doesn't require any user activity; just wait a moment. During the installation process, the installation application will create program folders and files, and Windows desktop and Start menu shortcuts.

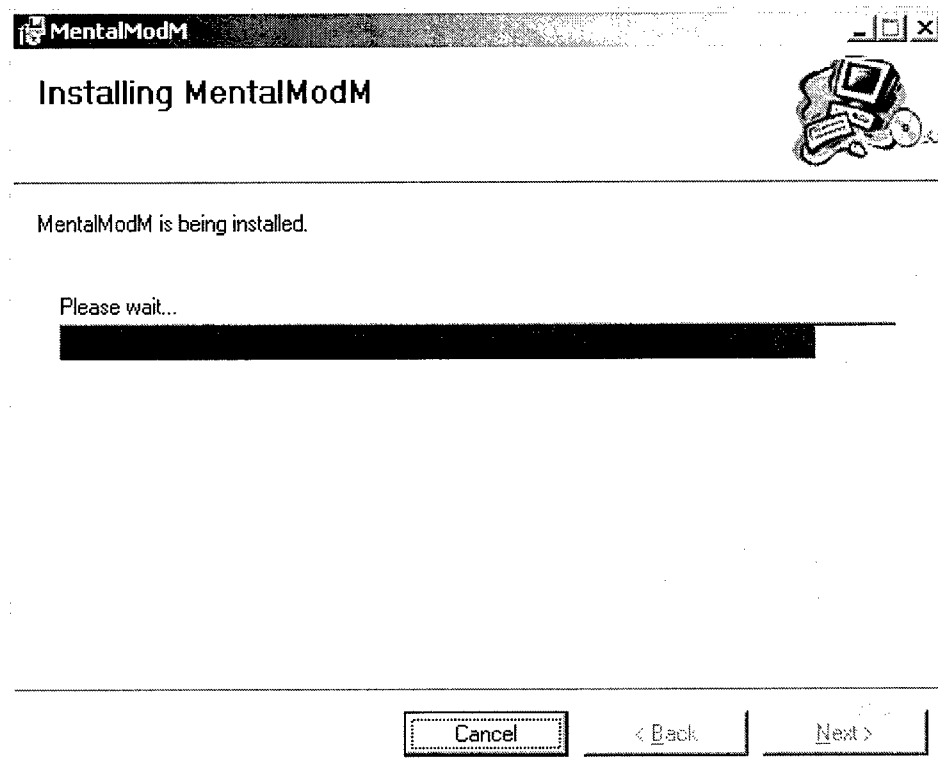


Fig. 4 The process page of the installation dialog

The sixth step is the final step in the installation process. Now you are ready to use the installed Mental Modeling and Training software.

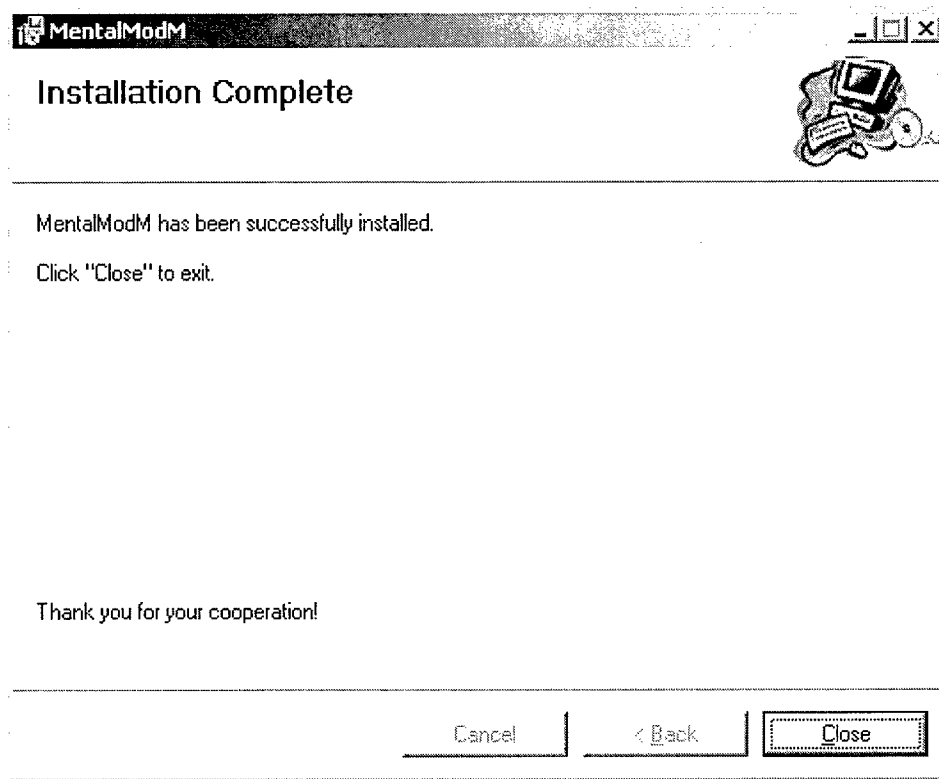


Fig. 5 The final page of the installation dialog

Mental Modeling

Getting Started

To launch the Mental Modeling software, locate the **MentalModM** shortcut on your desktop or in the **Start** menu.

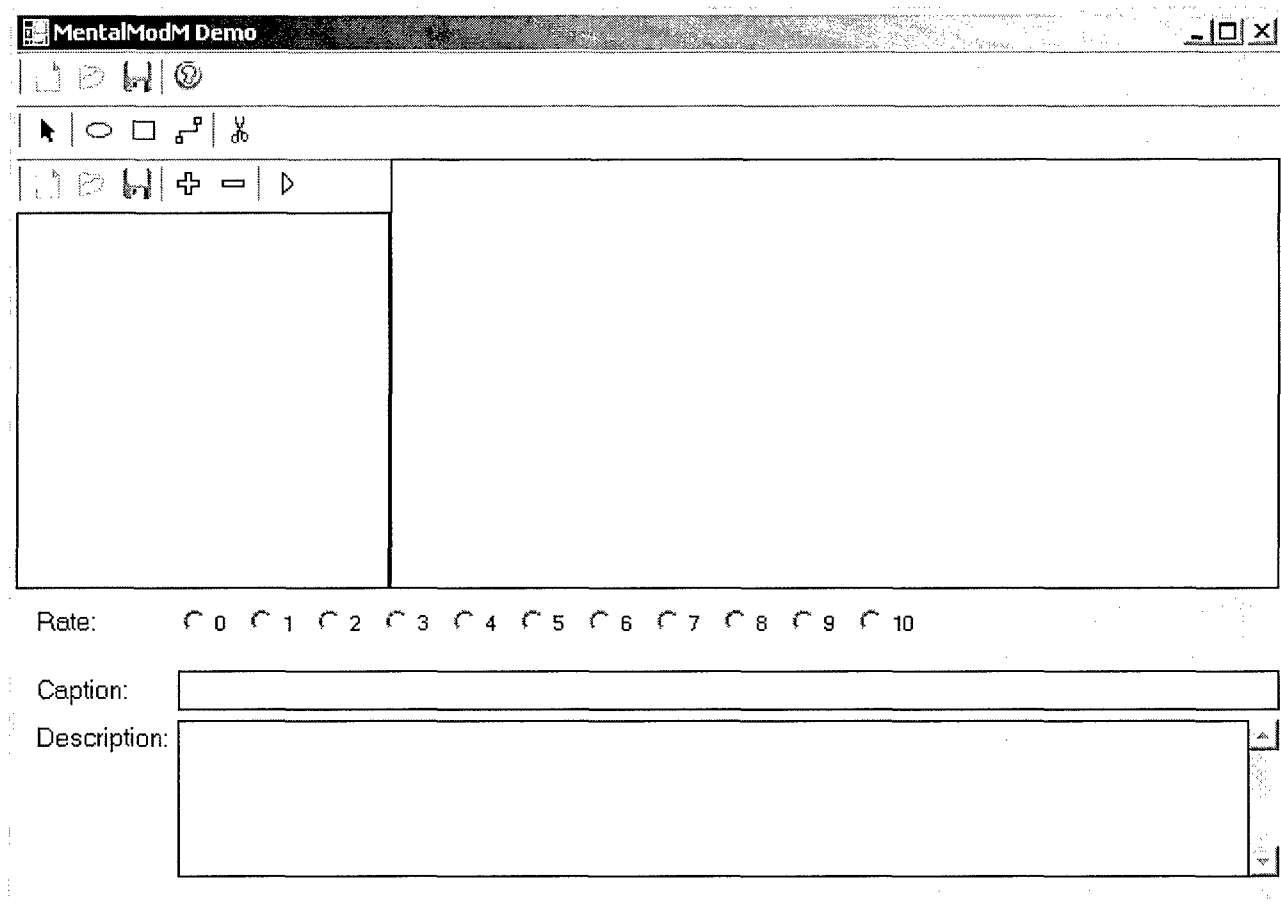


Fig. 6 The Mental Modeling application

Working with Charts

The Mental Modeling software is designed for creating and editing mind-map charts. To create a new chart, launch the application and locate the **New** button (1) on the top toolbar. Please be careful as there are two buttons with the same icon and name in the application window. The second button is located on the bottom toolbar and is used to create a new library instead of a new chart. If you have opened the application using shortcuts, you don't need to press the **New** button because in this case the application is ready to use and no chart is loaded in the **chart area** (10). To load a previously saved chart, use the **Open** button (2) and then choose a file from the list to be loaded from your hard drive. Please be careful in doing this, as your current and unsaved chart will be lost. To save the current chart, use the **Save** button (3) and then choose a location and filename for saving it on your hard drive. Use the **Help** button (4) to invoke this help file.

The mind-map chart consists of geometrical figures (ellipses, rectangles) and connectors between them. To create a new ellipse-based element, click the **Ellipse** button (6), move your mouse to the appropriate location in the **chart area**, then hold down the left mouse button and drag to adjust element size and geometry. To create a new rectangle-based element, click the **Rectangle** button (7) and follow the same instructions as for the ellipse-based element. To add a connector element, click the **Connect** button (8), use the mouse to point to the first element, then hold down the left mouse button and move the mouse to point to the second element.

To select an element in the **chart area** (10), click the **Select** button (5), move the mouse to point to the appropriate element, and left-click the mouse to select this element. A thin black rectangular frame, with points at the frame corners, appears around the selected element. You can use the mouse to move one of these points in order to change the selected element's geometry. To move the element, click the **Select** button (5), move your mouse to point to the appropriate element, then left-click the mouse and drag the selected element to its new location. You can move ellipse-based and rectangle-based elements, but you can not move connectors; instead, you must delete the old connector and then create a new one.

Each of the chart's elements can be named, commented on, and rated. To rate a selected element, choose a value from 0 to 10 on the **rate scale** (11). To set a name for a selected element, edit the text string in the **caption area** (12). To set a comment on a selected element, edit the text in the **description area** (13). To delete a selected element, use the **Delete** button (9). Please be careful in deleting an element, as all connectors currently connected to this element will also be deleted.

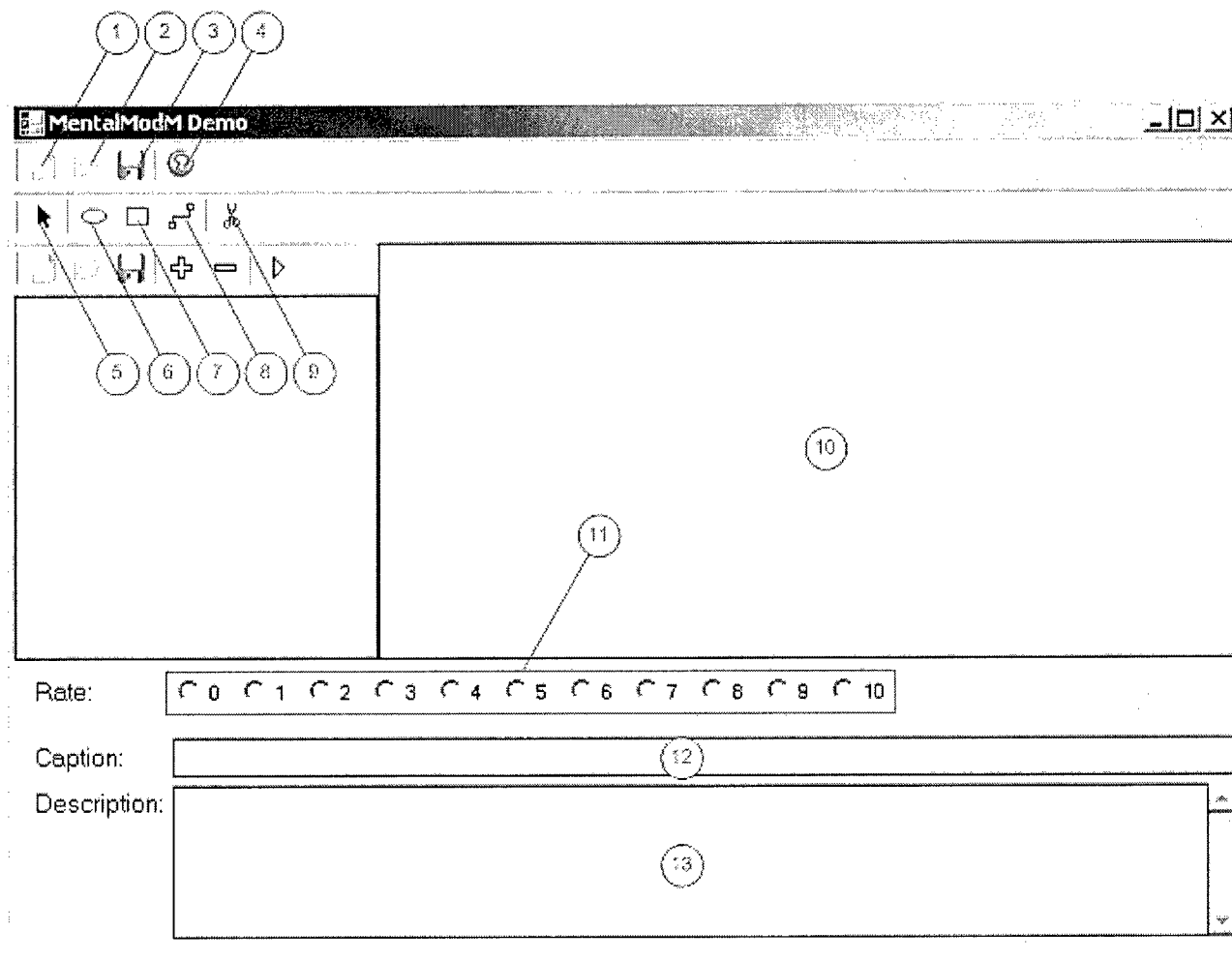


Fig. 7 Working with mind-map charts

Working with Libraries

Mental Modeling software enables the user to create, edit, and use element libraries. The element library consists of ellipse-based and rectangle-based elements with a pre-defined caption, description, and geometry. To create a new library, use the **New** button (1) on the bottom toolbar. If you have opened the application using shortcuts, you don't need to click the **New** button because the application is ready to use and no library is loaded in the **library area** (7). To load a previously saved library, use the **Open** button (2) and choose a file from the list for loading. Please be careful, as your current and unsaved library will be lost. To save the current library, use the **Save** button (3) and then choose a location and filename to save it to your computer.

To add a new element to the library, select an existing element from the chart area and then click the **Add** button (4). The new entry will appear in the **library area** (7). The name of the new entry will be identical to the element caption. It is not possible to add elements with the same name to one library. To place the new element on the chart area, click the **Create** button (6), move your mouse to the appropriate location in the chart area, and then left-click your mouse twice (double-click). If you want to create an element with custom geometry, follow the same directions for creating a simple element. To delete an entry from the library, select the appropriate entry and click the **Delete** button (5).

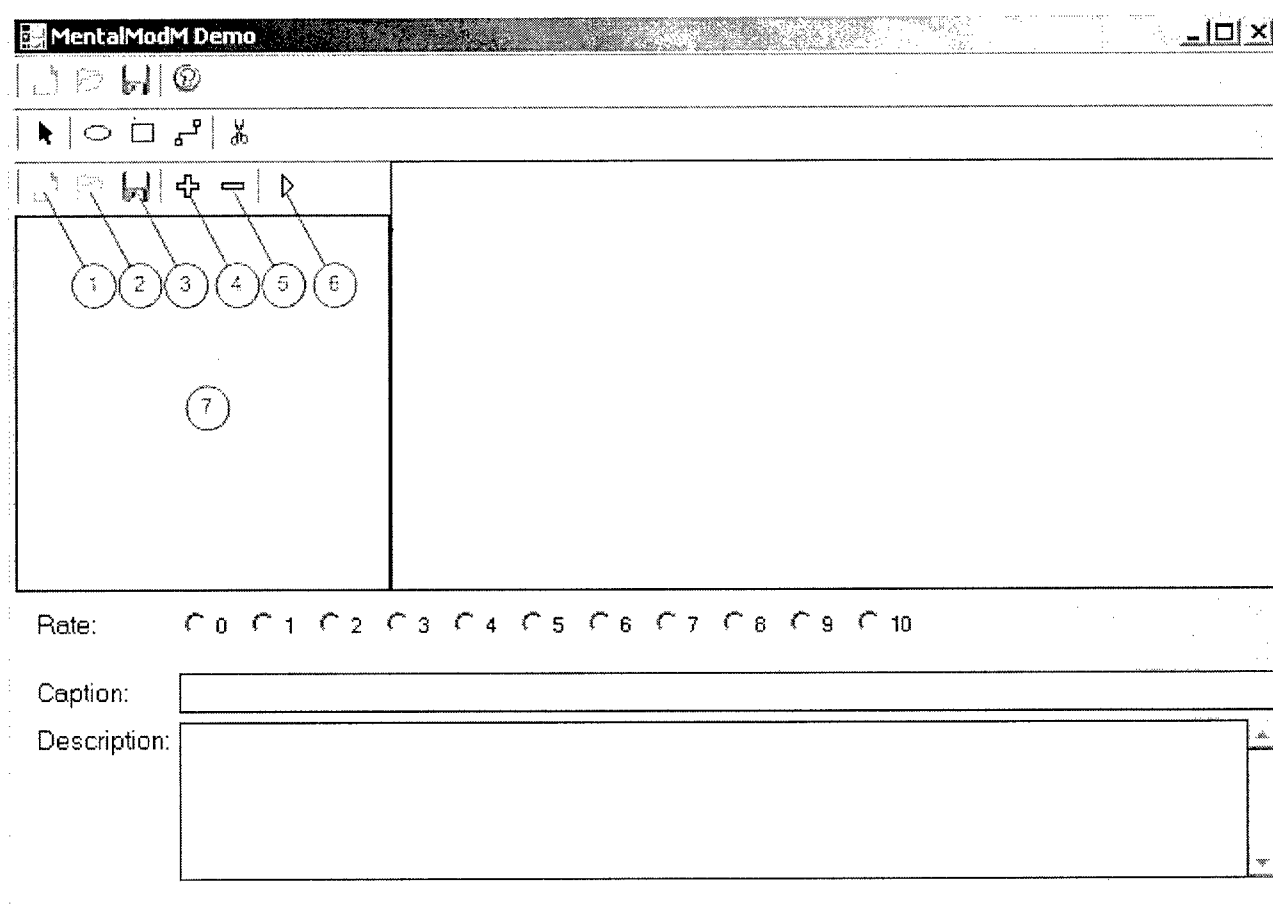


Fig. 8 Working with the mind-map library

Training Environment

Getting Started

To launch the Training Environment application, locate the **TrainingEnvironment** shortcut on your desktop or in the **Start** menu.

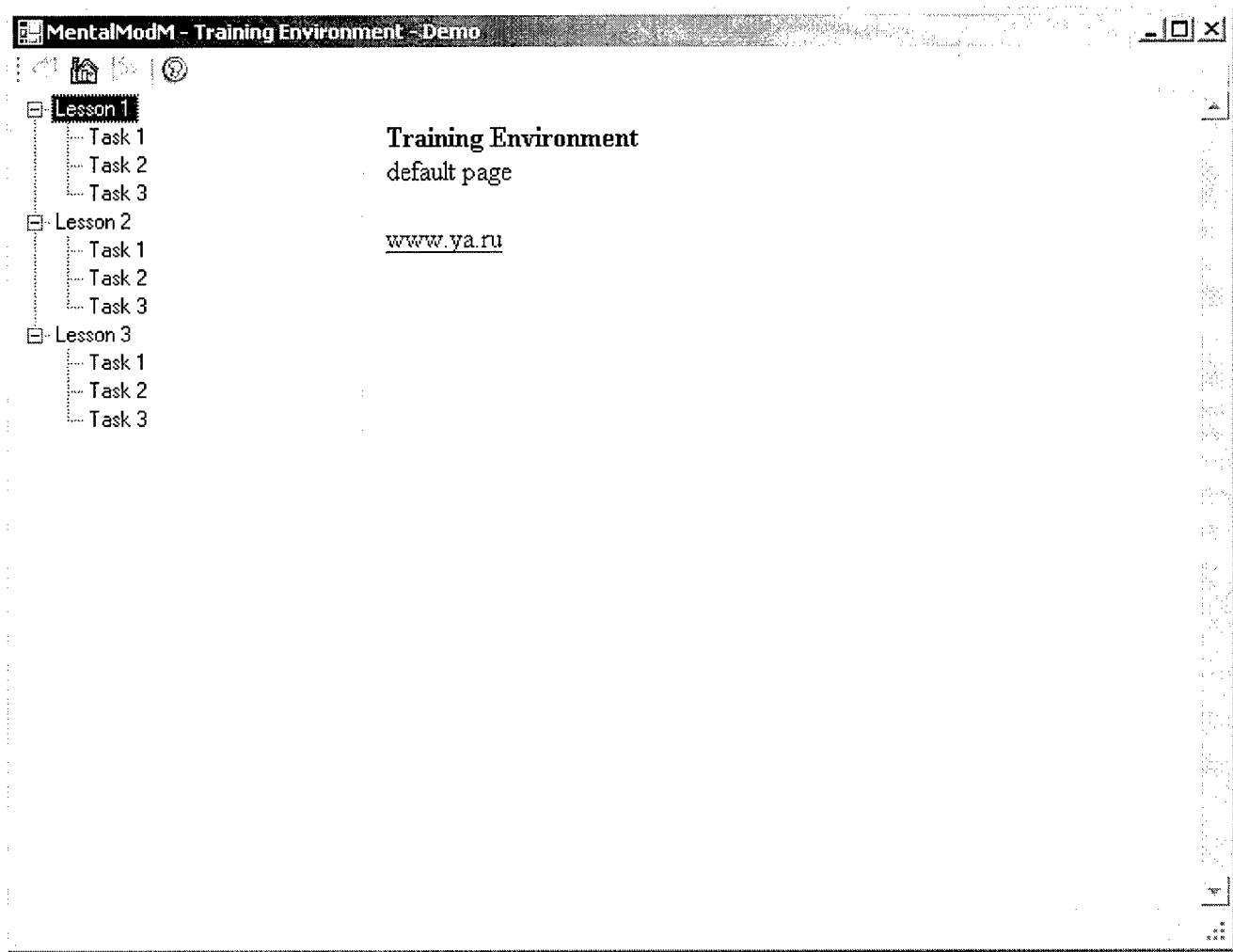


Fig. 9 The Training Environment application

Working with the Training Environment

The Training Environment software features a user-friendly interface to the training and methodological materials. This software is highly integrated with the Mental Modeling software via hyperlinks inside the **content area** (7), and it allows use of mind-map libraries and charts inside of the materials. You can launch the Mental Modeling application using the underlined **hyperlinks** (5) marked as blue or violet. Also, the **hyperlinks** (5) can be used for navigation to other materials, parts of materials, documents, applications or web-pages.

To easily navigate through the training materials, you can use the **navigation area** (6). Inside of this area, lessons and tasks are structured hierarchically. To open a lesson or task, select the corresponding entry in the hierarchical view inside of the **navigation area** (6). The lessons and tasks structure, as well as the training and methodological materials, are deployed as part of the installation package and can not be changed by the user.

There are some buttons that can be used for fast and easy navigation. To navigate to the previously opened page, use the **Back** button (1), and to return to the current page, use the **Forward** button (3). To navigate to the home page, use the **Home** button (2). To open this help file, use the **Help** button (4).

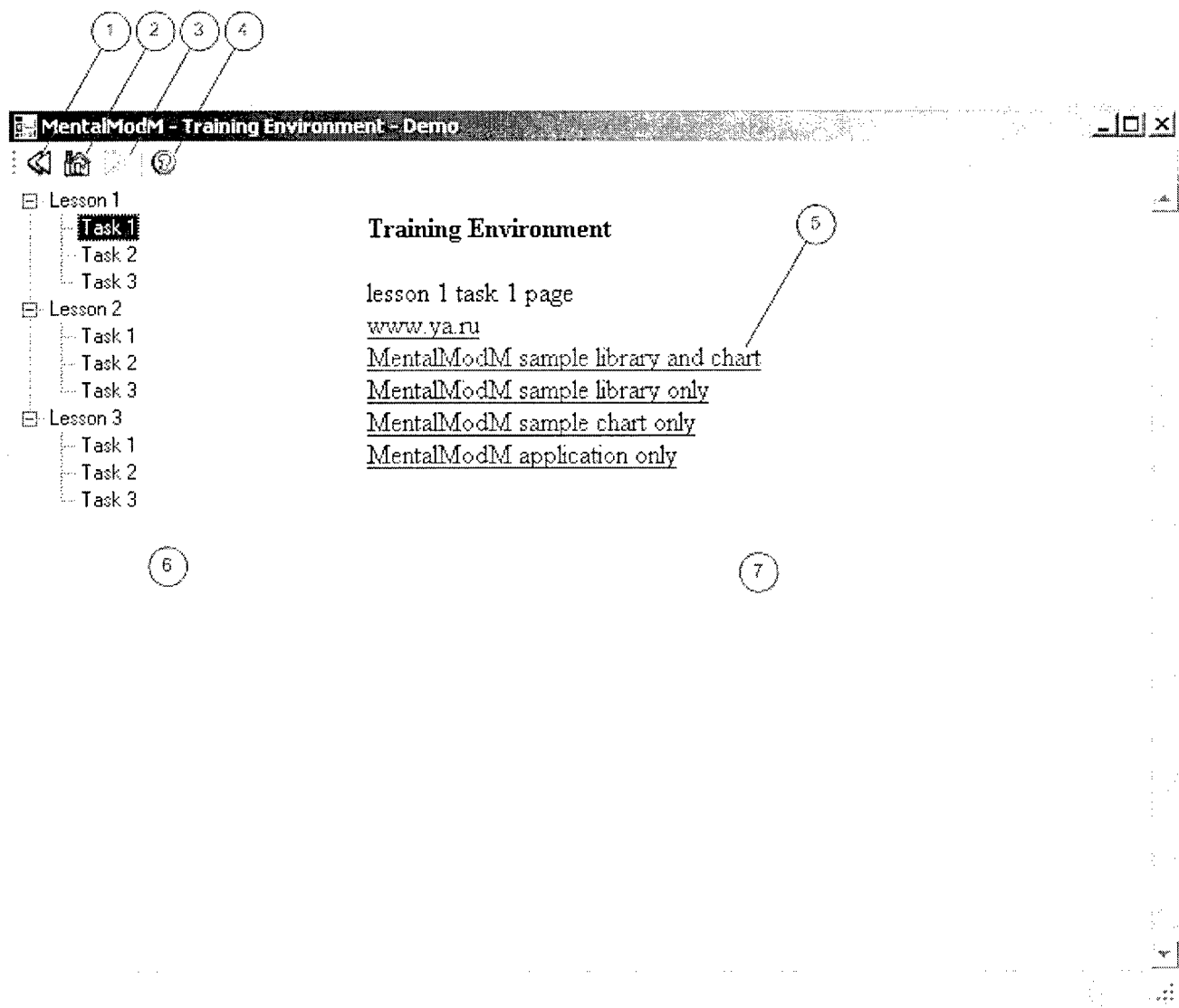


Fig. 10 Working with the Training Environment

Appendix B

Example Exercise Scenarios¹

Facts (From OSD DUSD (S&T) SBIR FY 2005.3 Program Description)

1. Focus is on Army staff members, but not limited by that parameter.
2. Future forces “must be interdependent with cultures of other Services, other governmental and non-governmental agencies, multi-national forces and the populations of countries in which operations are occurring.”
3. Key considerations are:
 - a. Staff Officers and Non-Commissioned Officers NCOs in a Joint Task Force (JTF).
 - b. “Differences among the Services with respect to Doctrine, Organization, Training and Education, Materiel, Leadership, and Personnel.”
 - c. Understanding of “tactical capabilities ... and the capabilities each Service brings to the Joint Battlespace.”
 - d. “Computer-mediated training methods to address ... issues associated with leader and staff effectiveness in Joint Task Forces.”
 - e. “Understanding of Joint capabilities encompasses Combat Arms, Combat Support, Combat Service Support, Reserve and National Guard components; all areas shall be considered.”

Constraints

1. “Computer-mediated training” must fit within a 2-hour block of time in order to be easily useable in the field and/or included in the academic environment.
2. The exercise scenarios must be current and relevant in order to hold student interest and facilitate learning.
3. The delivery method and scenario design must create an environment where it appears to the student that they are in a free-flowing/thinking environment in order to elicit higher level learning both in the cognitive and affective domains which will result in internalization of learning and behavioral change.
4. Scenario modules must be capable of running single player or multi-player modes.
5. Tutoring must be available within the simulation.
6. Student performance must be tested.
7. Feedback must be provided and included within scenario 2-hour timeline.

Restraints

1. Computer simulation must be user-friendly and cannot require significant student pre-training in order to use the modules.
2. Simulations must run self-contained and cannot require use of an instructor/facilitator.

Assumptions

1. Since the focus is on Army Staff Officers and NCOs in a JTF, focus of effort in Phase II will be on learning the capabilities of, and acculturation to, other Services, Interagency (IA), Multinational, Intergovernmental/Non-governmental entities and customs of populations in the Area of Operations (AO).

¹ This Appendix is written by Global Innovation & Design Associates, LLC under subcontract to Cambridge Environmental Inc.

2. Students will have had at least some exposure, via a 4-day indoctrination course at either the Combatant Command (CC) or JTF, or attended the Individual Augmentee training at JFCOM prior to being sent into theater.
3. If this training is not available, students will have some homework, prior to the simulation, to provide basic knowledge level material before beginning the simulation. Some basic knowledge of Joint Doctrine, Service/IA capability, and the AO must be already present in order to allow the students to apply their knowledge, be evaluated, receive feedback, and get tutoring in weak areas, all within 2-hours.
4. If necessary, assigned homework must be current, relevant, and written in a way that keeps the student interested; it must also require less than 2 hours to complete. From GIDA's significant adult teaching experience and extensive operational experience in the field, if these parameters are not carefully met, not only will the students not do the homework, but if they do attempt to do so out of a sense of duty, very little of the material will be available for recall the next day during the exercise.
5. Joint Staff Officers can be assigned to staffs and work issues at many levels of war from National Strategic to Tactical.
6. JTF Staff Officers often are intimately involved in working issues and providing advice to be passed up the chain-of-command for National Strategic decision-makers to act upon.
7. An understanding of the capabilities, requirements, and cultures of other Services, Interagency partners, and Multinational or Intergovernmental/Non-governmental entities at the different levels of war (Strategic, Operational, and Tactical) can greatly enhance Staff Officer ability to set the parameters of an operation correctly to achieve the effects desired at each level of war. Often actions at one level of war have dramatic impact upon the other levels.
8. These multiple training/education needs cannot be met simultaneously, but each level of war can be dealt with in a discrete 2-hour session. These sessions can be individually selected, based on priority of need for the Staff Officer position assigned or education program the student is attending.
9. These sessions or modules should flow coherently and logically from one to the other, in a nested method, in order for students to see the decisions made at one level and their impact upon other levels.
10. Students may only be able to use one module due to the amount of time available for education/training, so each module's learning objectives must be discrete and completed within that module.

Overall Exercise Design.

1. In order to address the disparate training/educational needs at the various levels of Staff Officer/NCO assignment, such as Strategic, Operational, and Tactical; we have decided to design three separate Modules and use a nesting method to link them together. This nesting method will allow each 2-hour module to be used independently, or in combination with any of the others, to see the impacts of decisions made at one level and their implications to the others. For example:
 - a. **Module #1** is a National Strategic level Interagency (IA) exercise where the student is assigned to a Deputy's Working Group, immersed in a realistic crisis situation (outlined below), and tasked to determine IA capability and National Response Options for consideration up the chain.
 - b. **Module #2** is a Theater Strategic or Operational level (CC or JTF) Joint Operational Planning Process (JOPP) crisis action planning exercise where the student is given decisions from the NSC, based on input from the Module #1

effort (or default parameters if Mod #1 has not been run), and works as part of a Joint Planning Group (JPG) to produce an appropriate military Course of Action in response to world events.

- c. **Module #3** is a Tactical level (Operation DIAMONDBACK JTF) Joint planning exercise where the student is part of a JPG tasked with final planning of a COA for the Multinational/IA operation that resulted from decision-making in Modules #1 and #2 (or defaults if not run).
2. Real-world (unclassified) processes unique to each level are used in the scenario design to immerse the student in those unique decision-making processes while performing the group tasks completion and creative thinking. Cultural and capabilities differences are addressed throughout the scenario through exercise design and Computer Generated Role Players (CGRPs)
3. Although some Learning Objectives (discussed below) will be strongly represented in each of the specific modules due to the scenario details, all learning objectives are addressed through other means such as role players, Mentor interaction, or direct injects. In this way, each module stands on its own and can deliver all priority learning objectives, assessment and feedback, and tutoring on weak areas identified at the AAR.

Overall Scenario:

President Karzai has been assassinated and Afghanistan is beginning to politically destabilize along tribal lines and geographically destabilize into warlord-controlled areas. Initial reports indicate that during a formal review of the Afghan Army in Kandahar, an Afghan Soldier being decorated by the President for recent SOF operations in Southern Afghanistan blew himself up, along with the President and several bodyguards. The Governor of the Province is in critical condition and two US advisors were killed as well.

Possibly due to previously coordinated efforts, this morning's reports indicate that a significant concentration of al-Qaeda operatives and Taliban forces have been discovered once again in the Shahi-Kot Valley and Arma Mountains southeast of Zormat. They seem to be massing for a major operation. This is the same area in which Operation ANACONDA was conducted in March of 2002.

Not surprisingly, an internet posting on a jihadist website this morning stated that "Allah's blessings are once again upon the **Mujahideen** as evidenced by recent successes by our Hezbollah brothers in Lebanon against the Zionist invaders and Allah's vengeance on the traitor Karzai for bringing the great Satan among us. We are calling upon all Muslim brothers everywhere to rise up and establish the long-awaited Caliphate, which was foretold in the Holy Book, and will usher in an era of Muslim prominence throughout the entire world."

NATO leaders in Afghanistan have indicated that the situation is precarious and that their forces are taxed to the limit in ongoing stabilization operations. They request the assistance of a US-led JTF to deal with the resurgence of enemy forces in the Shahi-Kot Valley.

Module #1 Scenario: (Strategic National Level)

You are on the Joint Staff (JS) J-3 and have been assigned this morning to an IA Deputy's Committee working group to analyze the situation and discuss IA capabilities and possible solutions to the situation in Afghanistan, in preparation for briefings to each of your Agency Deputies prior to the Deputies' meeting at 1100 and the National Security Council (NSC) meeting this afternoon. You will receive a VTC of the JS J-2 analysis of the situation and will have the remainder of the 2 hours to determine the proper military role(s) and how they will fit in with the entire (IA) national response to this crisis.

Module #2 Scenario: (Theater Strategic or Operational Level)

You are assigned to the J-35 on the Combatant Command (CENTCOM) Staff (Theater Strategic Level) or JTF (OEF) Staff (Operational Level) and are part of a Joint Planning Group (JPG) formed to put together the Commander's Assessment of the situation. The commander wants to exercise his option to not only provide assessments of the situation, disposition of forces, what he is doing with assigned forces (within approved policy), and time required for movement of forces; but he wants to also provide an initial recommendation on a rough Course of Action (COA). The JPG to which you have been assigned will focus on determining an initial rough COA. You will receive a VTC of the J-2 analysis of the situation that was completed this morning, disposition of forces, and SECDEF guidance generated from the NSC meeting this afternoon, and you will have the remainder of the 2 hours this evening to create a rough multinational COA to this crisis. Liaison Officers (LNOs) have been assigned from each of the services, IA and the donor nations.

Module #3 Scenario: (Tactical Level)

You are assigned to the JTF Staff that was recently created to conduct Operation DIAMONDBACK to destroy al-Qaeda and Taliban forces in the vicinity of the Shahi-Kot Valley and Arma Mountains southeast of Zormat. You are a representative from your Staff Section on the JPG comprised of representatives from all JTF staff sections, service component LNOs, Multinational LNOs, and the CC Joint Interagency Coordination Group (JIACG). You will receive a VTC of the J-2 Intelligence Preparation of the Operational Environment (IPOE) that was conducted the day prior, as well as products from mission analysis and initial COA development conducted this morning, and you will have the remainder of the 2 hours this afternoon to finalize a multinational COA in accordance with the Commander's Planning Guidance and higher HQ directives. Liaison Officers (LNOs) have been assigned from each of the services, IA and donor nations. You will have the benefit of computer simulation technology that can be used to briefly run the operation with a different mix of US and Multinational capabilities. Your team has been tasked to develop one COA dubbed COA SLAMMER.

Exercise Module Timeline Breakdown.

1. 2-hour timeline should be broken up into the following:
 - a. 5 minutes for Set for learning.
 - b. 7 minutes for Input for learning.
 - c. 35 minutes for student gaming interaction.
 - d. 10 minute break for head call, drink etc.
 - e. 42 minutes for student gaming interaction.
 - f. 8 minutes for student performance feedback in the form of an After Action Review (AAR).
 - g. 10 minutes for student selected tutoring to address identified weaknesses.

Learning Distribution.

1. Each exercise will be 2 hours in length and independent, but results in a higher-level module can be used to modify starting parameters in the lower module. This would allow the student to see the results of decisions at a higher level and how they impact lower levels. Additionally, showing them down-stream lets them enjoy a little "fruit of their labor" from work done in a higher-level module. This gives closure to previous work and reinforces learning.

2. As students log on to the module, they will be asked to input personal information to help the simulation focus on needed areas of learning and not duplicate areas they already know. Input information will include the command/billet they are assigned or enroute to, branch of service, rank, MOS/Branch within service, CGSC equivalent graduation, Joint, Multinational, IA, and AO experience. Since the exercise will only be 2 hours in length, it is important to focus on critical Learning Objectives (LOs). For example: if the student logs on as enroute to the J5 OEF JTF, an Army O4, CGSC graduate, with no Joint Experience, no multinational or IA experience, and is Branch Qualified as an Armor Officer, the exercise will put aside interactions with any Army officer Computer Generated Role Player (CGRP), Army TTP, Army Logistics, Army Movement and Maneuver, etc., that the student should already understand. This will free time to focus interactions with other service CGRPs for cultural differences, Marine TTP/logistics/maneuver from a perspective of differences from the USA, IA/Multinational capabilities/cultures, and OA cultural issues. Likewise, if the student logs on as enroute to the J4 OEF JTF, an Army National Guard O5, CGSC distance grad, no Joint/Multinational/IA experience, Logistics Branch qualified, the exercise may include some USA movement and maneuver, depending on the prioritized list of LOs. Joint and Multinational experience will allow the computer to focus more on the IA and OA.
3. The Learning Distribution will be as follows:
 - a. The Set should be the initial presentation of the crisis situation for the module. If done properly, the Set should introduce the desired learning for the module, show the student why the learning is relevant, and grab the student's attention. The Set is critical and should make them want to learn.
 - b. The Input is the step that provides the student information/learning that they will need to complete the task.
 - c. The "student gaming interaction" will be where a majority of the leaning will be happening. This will be where students are interacting with other entities to complete the assigned task. Other entities will include other students logged into the game, computer generated players, and a computer generated tutor/guide. Students will apply the knowledge level learning they have gained through previous training/education or homework.
 - d. Student performance will be evaluated, suggestions provided as needed, and performance critiqued at the AAR.
 - e. Links will be identified to provide additional training/education for areas of weakness identified at the AAR. We have set aside 10 minutes for students to conduct tutoring as they desire. If the students are not going to run another module, 3 minutes of this time can be spent on showing a snapshot of down-stream impacts of their decision making in the module just completed.
4. Key Learning Objectives (LOs):
 - a. During Phase II, detailed LOs will be created for each Module and prioritized. For each LO, Samples of Behavior (SBs) will be created and the computer simulation will focus on achieving these SBs to determine whether the LOs have been achieved. As LOs are achieved, the simulation can move on to other objectives and record results. Multiple LOs and SBs can be working simultaneously.
 - b. These Learning Objectives will include:
 - i. Major capabilities of the other services.

- ii. IA capabilities.
- iii. Multinational capabilities.
- iv. Interdependence.
- v. Service cultural differences.
- vi. IA cultures.
- vii. Multinational cultures.
- viii. NGO cultures.
- ix. OA cultures.
- x. Joint Operational Planning Process (JOPP).

Student Interface.

1. Student interface methods need to mirror, as closely as practicable, the collaboration tools that the student will utilize at the assigned billet at the JTF/CC in the real world. This not only makes the scenario more realistic, but it provides the added advantage of making the student more efficient/effective with real-world collaboration tools that are being used in the field.
2. The student interface will be as follows:
 - a. VTCs will be pre-recorded video clips of the JTF commander providing the Task, Purpose and Endstate, relevance to National Security, and timeline/general guidance. He will be followed by an abbreviated J2 IPOE briefing for a total of 5 minutes. The video will have the format and appearance of a real VTC, but the conversation will be only one-way.
 - b. The main student interface will be on a simulated IWS station. Input information will be posted to the bulletin board in the IWS briefing room for the student-assigned JPG. Input material must be put in a format that will enable students to digest information within 7 minutes. By posting this information on the Bulletin Board, students can refer to it throughout the exercise.
 - c. A list of JPG members, with backgrounds, will also be posted so that the students will know with whom they are working and discern where to go to get expert advice. Simulated pictures and background information can initially reinforce perceptions of other services, or begin the process of altering those incorrect perceptions. One method of breaking down preconceptions is to give the student a list of names, backgrounds, and simulated pictures and ask the student to choose a team out of that list to complete a task. Based on the student choices, some assumptions can be made about preconceptions. As the simulation proceeds, the student can be presented with problems that require help from non-chosen players to complete. The Mentor can recommend requesting their assistance, or the Computer Generated Role Player (CGRP) could volunteer to help. All student interactions with CGRPs (and CGRP to CGRP interaction) will include CGRP behavior that will work toward student learning about service cultural differences.
 - d. The main briefing items or visual aids for tasks being worked will be on the main screen. Students will type in questions, answers, directions, etc., at the bottom of the screen and, just like in real IWS, a Knowledge Manager will decide who gets to "speak" to the group and when. In this way, we can control the flow of the simulation. Additionally, just like in real IWS, the student can go to "Chat Rooms" for side-bar discussions.
 - e. "Student gaming interaction" will include IWS collaboration with the group, pop-up interactions with the assigned Mentor, running COA simulations at the

tactical level, and selected tutoring vignettes that the student either selects or is directed to for correction of a significant weakness identified during the exercise.

Module #1 details. (Strategic National Level)

1. **Challenges** that are presented by this kind of situation:
 - a. Since this module is at the National Strategic level, Input must be at the National Strategic level to include extremely distilled excerpts from the National Security Strategy (NSS), National Defense Strategy (NDS), and the National Military Strategy (NMS). Keeping the information to only the amount that can be read and digested in 7 minutes will be a challenge, but it can be done. For example, the NSS can be distilled to only one sheet that lists the 3 Goals and 9 Ways. NDS and NMS can, likewise, be distilled to a one-page "gouge sheet."
 - b. The Set must include a quick brief on how the IA process works, so that the student will know where they fit in and why their work is important.
 - c. Interaction and learning about IA capabilities and cultures will be the center of attention due to the module scenario, so service culture issues will have to be addressed in DOD-only Chat Room interaction on sidebar issues.
 - d. Since Deputies' Working Groups are by definition US-only, multinational capabilities and cultures will have to be addressed as informational injects or tutoring points. The State Department CGRP could possibly be used to inject the information, or a military CGRP with NATO experience could input the information during a DOD-only Chat Room exchange.
 - e. AO cultural issues will probably not be front and center unless brought in by the State Department CGRP, other IA CGRP, or an entity concerned with Strategic Communications.
 - f. If we are modeling real-world IA players and cultural differences, it will become very frustrating for the student that little seems to be getting accomplished and nobody seems to be willing to commit to any conclusions or decisions. Learning studies have shown that increasing stress does indeed improve learning to a point, but it sharply drops off after that. Using timeline and task prompts should be enough to get student stress up, but we will need to assign a Mentor in order to keep student stress from getting too high. The student can be introduced to the Mentor as a member of the JS J3 for the last 2 years, very experienced, highly respected, and from the exact same Service and Branch as the student. That way, the student should have a sense of trust and camaraderie with the Mentor. We can also use the Mentor to keep the student from getting bogged down too long on a task that is becoming unfruitful, since we only have 2 hours to complete all the learning.
 - g. Since the IA Working Group process does not follow the Joint Operational Planning Process (JOPP) per se, this LO will have to be injected at the end. One possible method of injection would be to have the Mentor perform a quick compare and contrast on the way this IA Working Group process worked and the JOPP.
2. **Excerpts** from the module:
 - a. Following the VTC, the Deputy's Working Group Chair reminds everyone that the tasks are to determine IA capabilities and possible US response options. He also informs everyone that key documents are posted to the Bulletin Board and that a map of Afghanistan is being projected on the briefing screen with current

US/NATO troop positions, known enemy dispositions, and key APOD/SPOD designations.

- b. The Chair opens the floor to response option suggestions. State Department CGRP starts off the discussion with a suggestion that diplomacy can still work if given a little time. He/she can state something like "we are currently in negotiations with the Afghan government to quickly name a replacement so that we can begin negotiations with the warlords. If we send in troops too soon, it could make things worse."
- c. Each Interagency CGRP mentions possible options from their perspective.
- d. The student will probably be uncomfortable with the fact that the group desires to look first at options before determining available capability. If not, the simulation will continue along this vein for 3 minutes, and then the Mentor will voice his frustration to the student about the backwards process. For example, the Mentor might say, "it is almost predictable that the IA players will want to get the cart before the horse in trying to talk solutions before they have identified capabilities. It wastes time discussing 'pie-in-the-sky' possibilities when we don't have the capability to enact them. It is so frustrating. We have to look for an opportunity to politely suggest a change in process." This should stimulate a discussion about whether it is appropriate to first look at options/objectives or available capabilities/resources. This "discovery learning" should only be allowed to continue for about 5 minutes.
- e. The simulation can make sure that the 8 minutes is not lost by having the Chair post the possible solutions that were already mentioned to the Bulletin Board for further consideration after capabilities are nailed down or visa versa.
- f. Each IA member then in turn provides a quick outline of their capabilities that might be helpful to this situation. This should be held down to 15 minutes at maximum.
- g. The discussion now returns to possible solutions. In order to keep new considerations before the student, hopefully ones that he/she has not considered or been exposed to before, the CGRPs suggest many options that do not include the military. Some possibilities are third party pressure on the enemy, economic sanctions against Pakistan, etc. Once 35 minutes have past, or the list of possible other options has been exhausted by the simulation, the military option comes up.
- h. The student should play significantly in this piece. State Department CGRP and a few others periodically insist that it be a multinational effort, be kept as one of a few options or at least be part of a multi-pronged engagement package. CGRPs will periodically inject their perspectives about the negative effects of military action on adjacent countries, Strategic Communications, the Middle East and the War on Terror (WOT) information operations (IO) campaign. The CIA rep and a few others will support the DOD perspective so that the discussion remains balanced.
- i. With 15 minutes remaining, the discussion will focus on how DOD should fit into the option menu.
- j. State Department will insist that if the military option is exercised that it must include a package to boost coverage of US humanitarian activities throughout the Muslim world to offset the negative SC impact of military action in Afghanistan.
- k. The group never really comes to complete consensus, which is typical, but there are several "camps" that develop that support specific positions.
- l. The learning can be controlled through CGRP injects and Mentor interaction with the student. It should appear to be a free-flowing discussion throughout.

- m. All CGRP will behave throughout the exercise in a way that highlights cultural issues. The CGRP behavioral flow will walk the student through the learning objectives that deal with cultural differences between services, the IA, etc., without the student even knowing.

Module #2 details. (Theater Strategic or Operational Level)

1. **Challenges** that are presented by this kind of situation:
 - n. There is not enough time to take the student through the entire JOPP. The Set and Input provide the student with the products from the IPOE and Mission Analysis. The bulk of the exercise time is spent on the COA development phase of JOPP. So the remaining steps must be injected. One method could be as follows:
 - i. Once the COA is completed, the Mentor could ask the student what will happen to their COA and how it will be beneficial to the planning process. This will require the student to think about how their COA will be improved during Staff Estimates, Wargaming and COA Selection.
 - ii. Additionally, we could show students the final outflow of their planning efforts, resulting in a Commander's Assessment going up the chain and, since the COA was so good, the Warning Order step gets skipped and an Alert Order comes back down to the JTF/CC Staff.
 - o. Dealing with all the possibilities in developing a COA will be a challenge. One way to keep the variables under control would be to already have Phases I and II completed and Phase IV and V completed. These Phase Concept of Ops sketches could be posted to the IWS Bulletin Board. Then the JPG Lead can focus the group effort on making Phase III start with the ending conditions of Phase II and complete the Objectives that must be accomplished to start Phase IV properly. This will give the student and the JPG enough time to come up with a reasonable product in the time allotted.
 - p. In COA development, the student must determine the Objectives, Effects, Tasks, and Resources by phase. Another way to control the variables would be to provide the Objectives and Effects to the JPG and then let them determine the Tasks, Resources and the scheme of maneuver. We must decide in Phase II if we desire the students to wrestle with deciding Effects. If they have not done it before, it may take quite a bit of prompting by the Mentor and other players (and time) to get through that stage. Since the Army has not yet fully embraced Effects-Based Planning, I recommend that we let the students pass that part for now.
2. **Excerpts** from the module:
 - a. Following the VTC, the JPG Lead reminds everyone that the task is to quickly craft a rough course of action that can be sent in the Commander's Assessment that will provide a possible military COA very early in the decision-making process to influence the National Strategic level.
 - b. The JPG Lead informs everyone that the J3 and J5 have been in contact with the JS and a tentative apportioned force list has been provided. With that information, the J35 this afternoon has quickly crafted Phase I and II sketches, since those phases are very straightforward and constrained by AO conditions and the TPFDD. That information has been posted to the Bulletin Board.
 - c. The JPG Lead also informs the team that he/she had a short meeting earlier this afternoon with the Commander, J3, J5, COS and other key staff members and

they have come up with a rough sketch of Phases IV and V for the same reasons. They felt that the "heart of the art" was in Phase III and needed a JPG to complete the COA. This information has, likewise, been posted to the Bulletin Board.

- d. Finally, the JPG Lead informs everyone that key documents are posted to the Bulletin Board and that a map of Afghanistan is being projected on the briefing screen with current US/NATO troop positions, known enemy dispositions, and key APOD/SPOD designations. He also states that the JIACG has been in contact with some of the members from the Deputy's Working Group that met early this morning and has posted the IA capabilities that were discussed and National Response options.
- e. This JPG Lead briefing and digesting of the information should take no more than a total of 15 minutes. If the student begins to get bogged down, the Mentor reminds the student that the information will remain available for use through the planning task, since it is posted to the Bulletin Board. This will leave 62 minutes for the remainder of the "student gaming interaction" time.
- f. All CGRP will behave throughout the exercise in a way that highlights cultural issues. The CGRP behavioral flow will walk the student through the learning objectives that deal with cultural differences between services, the IA, Multinationals, and local populations, etc., without the student even knowing. Using the LNO CGRPs to facilitate this cultural learning simultaneously with student analysis, group interaction, decision making, creative thinking, and application of the knowledge of the JOPP will save quite a bit of time and allow the exercise to cover all learning objectives more effectively.
- g. The JPG Lead will ask for quick suggestions about getting the tasks done within the short time allotted. The student should suggest breaking up into groups to create whatever Objectives, Effects, Tasks, and Resources that have not been given to the group. Likewise, smaller groups will need to be broken out to complete other tasks such as the timeline for the Phase, Intent, scheme of maneuver, and C2. Sorting out time to tasks should only take 5 minutes, due to the fact that the JPG Lead CGRP will call a halt to the discussion and provide the final decision to the group, just like in the real world.
- h. The JPG Lead will assign personnel to the sub-groups based on experience (learning needed) and tell them to get to work in Chat Rooms and come back to brief the group in 20 minutes. The JPG Lead also informs everyone that all 5 sub-group briefs will be kept to 3 minutes each with significant information being posted to the Bulletin Board and briefing slides projected on the main screen to save time. Total briefing time will be 15 minutes. That will leave a total of 22 minutes remaining in the "student gaming interaction" time.
- i. In this way, we can further control student learning by not placing him/her into sub-groups for tasks that they are already familiar with. The student will still get some exposure to the processes and decision-making of the smaller groups through the overall group briefing.
- j. Then as a JPG they will spend the remaining time synchronizing different resources and the scheme of maneuver. This will facilitate learning about significant capabilities other services and multinational entities bring to the fight. Since time is short, the students will only deal with above-the-line forces.
- k. If logistics issues do not come up in the student interaction to the degree desired, an academic inject can be designed as a backup. In order to facilitate service/multinational differences in logistics, which is very important, the simulation can dedicate a discussion time to make sure it is injected. A final out-

brief of the COA Concept of Support can be injected in the final 7 minutes of the “student gaming interaction” time to make sure this material is covered if needed.

Module #3 details. (Tactical Level)

1. **Challenges** that are presented by this kind of situation:
 - a. With only 77 minutes of “student gaming interaction” time available, it will be a challenge to address all student learning objectives on JOPP, Cultural Differences, and Capability Differences, and use 2D simulation technology for Wargaming the COA. If we give the student the COA sketch from higher HQ (Module #2), which is realistic, that would cut down on development time quite a bit.
 - b. Likewise, in the 2D Wargaming simulation, if we use predetermined capability loads to highlight capability differences in services and multinationals, and let the Wargaming runs go through without significant student input, the time savings would be significant. The students could select predetermined Wargaming packages, then select “run” (like in JFAST) and watch the action run to the end without input from the student. The student could then change the load selection and run it again and note the differences.
 - c. We could possibly allow the option for free-flow student interaction with the Wargaming simulation with the 2D model, but hold it back till other higher priority LOs are accomplished. If given the option, due to my experience in teaching JOPP to Field Grade and Senior Officers from all services, I suspect that they will spend an inordinate amount of time with the 2D model if allowed to do so. The 2D model will, however, be excellent for allowing the students to see capability differences in action.
2. **Excerpts** from the module:
 - a. Following the VTC, the JPG Lead reminds everyone that the task is to finalize a course of action to conduct Operation DIAMONDBACK to destroy al-Qaeda and Taliban forces in the vicinity of the Shahi-Kot Valley and Arma Mountains southeast of Zormat.
 - b. The JPG Lead informs everyone that KEY JOPP planning information is posted to the Bulletin Board, in a condensed format, including an CC/OEF JTF OPORD with TPFDD, and that a map of Afghanistan is being projected on the briefing screen with objective areas, current US/NATO troop positions, known enemy dispositions, and key APOD/SPOD designations.
 - c. With that information, the J35 early this morning quickly crafted Phase I and II sketches, since those phases are very straightforward and constrained by AO conditions and the TPFDD. That information has also been posted to the Bulletin Board.
 - d. The JPG Lead also informs the team that he/she had a short meeting earlier this morning with the Commander, J3, J5, COS and other key staff members and they have come up with a rough sketch of Phases IV and V for the same reasons. They felt that the “heart of the art” was in Phase III and needed a JPG to complete the COA. This information has, likewise, been posted to the Bulletin Board.
 - e. The JPG Lead reminds the team that 2D Wargaming simulation technology is available for their use in determining optimum use of diverse US/IA/Multinational capability, including a load that runs Operation

ANACONDA from March 2002, but advises them to not get bogged down since time is short for completion of the assigned planning tasks.

- f. This JPG Lead briefing and digesting of the information should take no more than a total of 27 minutes. If the student begins to get bogged down, the Mentor reminds the student that the information will remain available for use through the planning task, since it is posted to the Bulletin Board. This will leave 50 minutes for the remainder of the "student gaming interaction" time.
- g. All CGRP will behave throughout the exercise in a way that highlights cultural issues. The CGRP behavioral flow will walk the student through the learning objectives that deal with cultural differences between services, the IA, Multinationals, and local populations, etc., without the student even knowing. Using the LNO CGRPs to facilitate this cultural learning simultaneously with student analysis, group interaction, decision making, creative thinking, and application of the knowledge of the JOPP will save quite a bit of time and allow the exercise to cover all learning objectives more effectively.
- h. The JPG Lead will ask for quick suggestions about getting the tasks done within the short time allotted. The student should suggest breaking up into groups to create whatever Objectives, Effects, Tasks, and Resources that have not been given to the group. Likewise, smaller groups will need to be broken out to complete other tasks such as the timeline for the Phase, Intent, scheme of maneuver, and C2. Sorting out time to tasks should only take 5 minutes, due to the fact that the JPG Lead CGRP will call a halt to the discussion and provide the final decision to the group, just like in the real world.
- i. The JPG Lead will assign personnel to the sub-groups based on experience (learning needed) and tell them to get to work in Chat Rooms and come back to brief the group in 20 minutes. The JPG Lead also informs everyone that all 5 sub-group briefs will be kept to 3 minutes each with significant information posted to the Bulletin Board and brief slides projected on the main screen to save time. Total briefing time will be 15 minutes. That will leave a total of 10 minutes remaining in the "student gaming interaction" time.
- j. In this way, we can further control student learning by not placing him/her into sub-groups for tasks that they are already familiar with. The student will still get some exposure to the processes and decision-making of the smaller groups through the overall group briefing.
- k. Then as a JPG they will spend the remaining time synchronizing different resources and the scheme of maneuver. This will facilitate learning about significant capabilities other services and multinational entities bring to the fight. Since time is short, the students will only deal with above-the-line forces.
- l. If logistics issues do not come up in the student interaction to the degree desired, an academic inject can be designed as a backup. In order to facilitate service/multinational differences in logistics, which is very important, the simulation can dedicate discussion time to make sure it is injected. A final out-brief of the COA Concept of Support can be injected in the final 5 minutes of the "student gaming interaction" time to make sure this material is covered if needed.